THE SCHOOL JOURNEY.

JOSEPH H. COWHAM.

Additional 'Journeys' by
GEO. G. LEWIS & THOS. CRAWSHAW.

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THE SCHOOL JOURNEY.

A means of Teaching Geography, Physiography, and Elementary Science.

~~Ed/131~~ Ed/76

By JOSEPH H. COWHAM,

Lecturer on Education, Westminster Training College, S.W.

AUTHOR OF 'GRAPHIC LESSONS IN PHYSICAL AND ASTRONOMICAL GEOGRAPHY,' 'THE PRINCIPLES OF ORAL TEACHING AND MENTAL TRAINING,' 'SCHOOL ORGANIZATION, HYGIENE, AND ETHICS,' 'A NEW SCHOOL METHOD,' AND 'MULHAUSER MANUAL OF WRITING.'

WITH ADDITIONAL 'JOURNEYS' BY GEO. G. LEWIS, HIGHER GRADE SCHOOL, BELLENDEN ROAD, PECKHAM, AND THOMAS CRAWSHAW, WESLEY SCHOOL, PADIHAM, LANCASHIRE.

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PREFACE.

The 'School Journeys' herein described are not ordinary school excursions. A Journey which results in the pleasurable exercise of the observing powers upon a great variety of attractive objects, but which does not attempt to trace the deeper connections of causal relationships between any of them, will not effect much that is of real educational value.

Objects must be observed, it is true, in every School Journey, but the main aim of the following journeys has been to discover, as far as possible, the natural relationships existing between a few objects carefully selected for special enquiry.

These relationships advancing from striking and obvious associations to more subtle connections, viz., those of cause and effect, demand the exercise of much higher forms of intellectual effort than that of observation. The successful exercise of these higher faculties—imagination and reason—requires very thorough preparation before entering upon the journey. The permanent acquisition of knowledge in the field depends very largely upon that which his class-room preparation has led the scholar to anticipate. The pupil sees most clearly what previous study has given him the power (ability and knowledge) to see.

These considerations—the result of experiments in School Journeys during the last twenty years—explain the general plan and aim of the following chapters. Preparation of the essential features before the journey, associations leading to the discovery of relationships of cause and effect during the journey, and application of the knowledge gained to fresh cases after the journey, form the threefold condition of successful effort in this new branch of educational method.

My thanks are due to Messrs. Lewis and Crawshaw (former students at Westminster) for accounts of their journeys, and for the photographs and maps which they have generously supplied; also to my colleague, Mr. Kay, to J. A. Carter, Esq., B.A., and to Mr. Leslie Cowham for photographs of views of Caterham and district; and, lastly, to Messrs. Clarke and Litton, tutors at Westminster, for assistance in the drawings and in the reading of proofs.

JOSEPH H. COWHAM.

Westminster Training College.

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SCHOOL JOURNEY FROM LONDON TO GODSTONE

(SURREY).

Introductory. The following journey was first attempted in the year 1877. With one exception it has been taken in each of the subsequent years. A brief account of this 'Journey' was given in a paper entitled 'Subsidiary Aids to Instruction,' which I read before the Educational Congress, South Kensington, 1884. The Queen's Scholars of Westminster Training College, sixty in number and divided into two groups of thirty, are each year conducted over the journey. The main objects of the ramble are:—(1) To gain a direct knowledge of the physical geography of the district, and to supply, as far as possible, a reason for the most striking geographical features by references to the geological structure of the area; and (2) To present to young teachers a typical excursion upon which they may fashion other journeys. Teachers who have profited by the experience thus gained have planned for themselves and have carried out similar journeys over different areas of England. The 'journeys' of two of these pupils from Westminster are described in subsequent pages of this book.

The account of the journey from London to Godstone may be briefly arranged under the following headings, viz.: (1) **Class Preparation,** (2) **The Railway Journey,** and (3) **The Walking Tour.**

(A.) CLASS PREPARATION.

I cannot too strongly impress the importance of a thorough preparation of the class before attempting the journey. All the members must be imbued with a common aim. The desire to observe and completely understand a few well-marked physical phenomena must be aroused before the actual outdoor effort is begun, otherwise divided interests will tend to weaken the field effort, and to lessen the general educational effect. I find it also necessary, at the outset, to make very clear the notion that the school ramble is not an ordinary excursion. The idea of work and not play must be associated with each stage of the exercise. To tell the pupils that they are about to be taken for a ramble in the country may arouse an agreeable state of mental expectancy; but this alone will not be the condition of mind necessary for understanding the geographical features of the district traversed. It is not so much the sight of surface forms—hill, valley, stream, etc.—but rather, the effort to connect these forms with the natural forces which have brought them about that is of value. A valley with its winding course, its woody slopes, and fertile fields, is a very attractive feature. The town scholar will be delighted with the prospect, and the view may live for many months as a precious possession in his memory. A possession of much higher value, however, for geographical study, is the ability to associate the various features of the valley with the agencies which have produced them. The valley is an effect; it has a history. Can the cause be determined? Can the history be made known? If so by what means? How far can the scholar be led to unravel this history by an exercise of his own thought?

In answer to these important questions, it may be said that looking at the valley or walking along it will accomplish very little. The mind of the pupil must be prepared. He must bring with him a good stock of knowledge gained in the class-room by the study of maps, sections, and plans. The nature of this preparatory exercise must now be explained. In order to make the explanation full and definite, it is proposed to state exactly the line of preparatory enquiry adopted in a class which has frequently profited by the 'Journey.' My readers will understand, at the outset, that the following plan of procedure can only be illustrative of the *method* of preparing for, and of conducting, a 'School Journey.' The *matter* dealt with must vary with every district. The *method* of study will, however, be the same whatever the district selected.

Class-room Study of the Map.

The map of the route from Charing Cross to Tilburstow Hill (Fig. 1) is, in the first instance, thoroughly mastered. An ordinary lesson in geography, in which the succession of physical features is graphically described, is given. The map is studied until it can be reproduced from memory. The degree of success with which different pupils can read a map varies very much. Some appear to have the power to produce in their minds a very good outline of the natural phenomena—plain, hill, range, valley, etc.—and they are equally ready to recognise each of these features in the field when it is seen. This power to recognise a striking, natural feature in the midst of much variety of geographical detail gives great satisfaction to the learner. Other pupils manifest less ability. The difference is largely due to early experience. Those who have lived in the dales of Yorkshire or Derbyshire, or amid the picturesque scenery of Devonshire and Cornwall, are, as a rule, most apt. A few 'Journeys' in every school properly planned and conducted, help to make this difference of ability less marked. The out-door effort, furthermore, tends to make the future class-room study of the map much more realistic and hence much more interesting and profitable.

Over and beyond acquiring the names of valleys, plains and hill ranges, and the order in which these occur on the map, an attempt is made by oral description on the part of the teacher, and by an imaginative effort on the part of the learner to anticipate the actual appearance

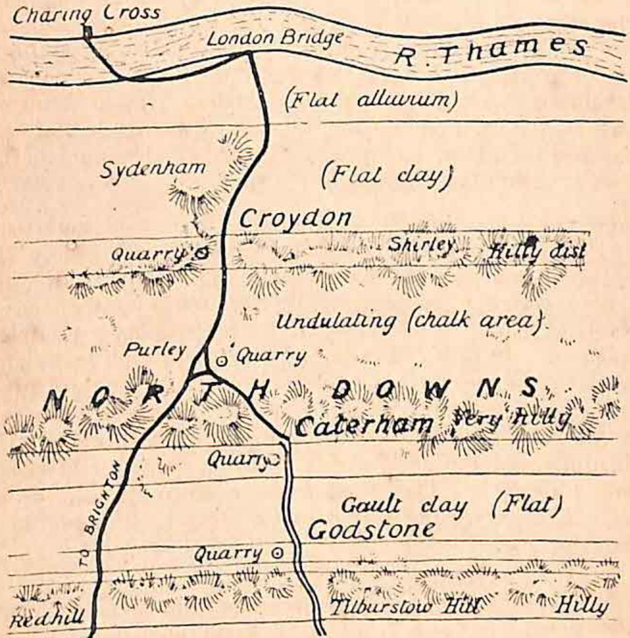

FIG. 1.—Map of the District showing only those striking geographical features which are to be recognised in the outdoor ramble.

these present in the field. The account of this portion of the preparatory work necessitates the repetition of details which will afterwards be more fully understood when these are brought under actual observation in the field. Revision and repetition are, however, features in all school acquisitions which are intended to be permanent, and, as this account is intentionally a presentation of actual school effort, the repetition of the same geographical facts, first in the schoolroom, and afterwards in the field, will, I trust, be excused.

Class-Room Study of the Plan of the district.

The Plan of the District is next presented. This plan is drawn in different colours. The colours used bear as close a resemblance as possible to the colour of the rocks found in each district. Thus clay districts are marked in blue, gravel in pale brown, chalk in yellow, etc. When this 'plan' has been carefully constructed and the rocks indicated have been identified by means of specimens taken from the School Museum, the pupils are asked to compare the map with the plan. These are placed side by side for better comparison, and, as a result, associations between geographical surface features and the character and changes in rock structure are readily made. The following are some of the most striking of these associations:—

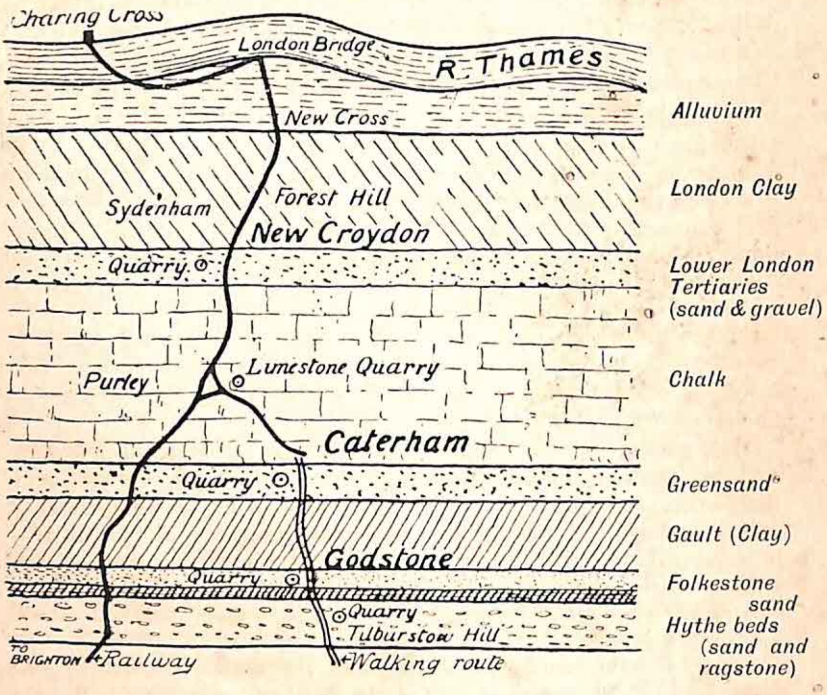

FIG. 2.—Plan of the Journey, showing the different geological formations crossed during the ramble.

> The district on the above map immediately in the Thames Valley, and stretching a mile southward from the river towards New Cross, is a low-lying flat. This flat is now connected with the rich deposit of alluvial mud deposited by the river, as shown on the plan. The rich alluvial soil is afterwards associated with the actionof the river Thames, which, during past floodings and very high tides, overflowed its banks and left a deposit of fine mud upon the flooded area.

The alluvial area just described is followed by the clay district. This is shown on the plan to reach from New Cross to Croydon. The clay tends to weather quite flat. To impress this, reference may be made to the efforts made by the railway companies round London to keep the clay from filling their cuttings. Trenches are dug, and afterwards filled with a binding material such as chalk. The class is told to watch for sliding clay and chalk trenches when passing by rail over this part of their journey. They will then be able to associate the level character of the country between New Cross and Croydon, as shown on the map, with the presence of the clay shown on the plan. Most districts in England present instances of this tendency to flat weathering on the part of clay. Reference may also be made to certain growths highly characteristic of a clay surface. Rushes and the plant commonly called 'coltsfoot' may be quoted.

Beyond Croydon a reference to the plan shows that the clay gives place to the sands and gravels called the *Lower London Tertiaries.* The scenery at once changes. Instead of the level plain are the beautifully picturesque hills of Shirley, Addington, and Hayes Common. The position of Shirley is indicated on the map. Many pupils in South London have visited one or other of these hills during their school excursions. A pupil might be asked to describe the chief features of the district. These are well-wooded hill tops, steep sandy or gravelly slopes, and mounds covered with either heather or the tangling blackberry bush. Here again is an instance of change in surface aspect due to the change in rock structure.

Half-a-mile further south the surface again changes. The long and monotonous curves (undulations) of the chalk Downs, with their scanty soil and short herbage, form a most striking contrast with the steep and well-wooded hills just passed. The chalk area is seen on the plan to extend to a line a little south of the village of Caterham. The map enables the pupil to associate this chalk area with the ridge of hills called the 'North Downs.' London scholars are frequently taken on excursions to Epsom Downs. The monotonous character of the surface aspects of this district is well known. Recall them, and lead the class to expect similar appearances in the district to be visited. Similar areas are found throughout England to the east and south of a line joining Flamborough Head with Portland. Salisbury plain is another example of long monotonous chalk undulations in the south.

Comparison of Map with Plan over the regions beyond Caterham.

The method of class-room preparation detailed above may, with advantage, be continued throughout the course of the journey beyond Caterham. The 'plan' indicates the somewhat rapid changes of rock structure south of the 'Downs.' A distance of about two miles brings to view the exposed edges of not less than four very distinctly different kinds of rock. There is, immediately after the chalk, a small area of gritty rock called

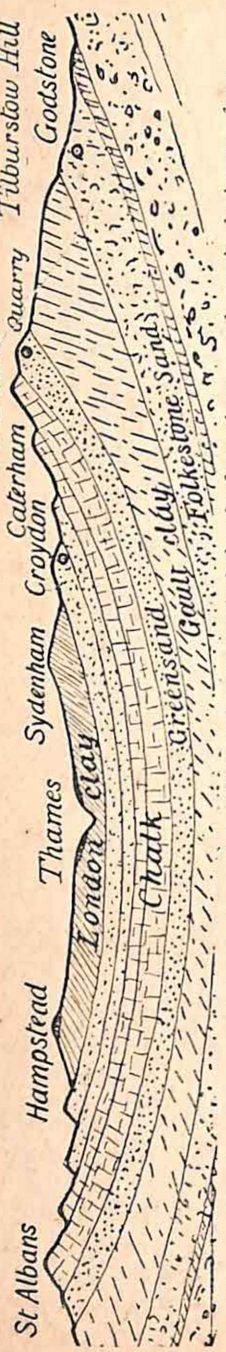

FIG. 3.—Showing arrangement of rocks beneath London, and, more particularly, the formations passed over in the journey from Caterham to Tilburstow Hill.

the *greensand*. This is followed by a very dark, close-textured clay called the *gault*. The gault clay repeats all the surface appearances of the London clay above described. If the map be now consulted, the gault clay area will be recognised as the flat plain-like district represented immediately south of the North Downs. A fine silver sand (the Folkestone sand) is next reached, and the country immediately becomes undulating. Lastly the rocks change to a hard building stone and an iron-banded sand called the Hythe beds. The iron bands resist decay and weathering, and the country rapidly rises in height until Tilburstow Hill is reached, at a height of about 600 feet. The plan indicates the limits of these beds of iron and sandstone rocks, whilst the map represents the changes in surface aspect due to the appearance of these sandstones.

During the journey no effort will be spared to connect the constantly changing aspects of the country with the frequent changes in the rocks of the district. It is in this association of change of rock with change of scenery that the value of the exercise chiefly rests. Furthermore, if the scholar can securely fix these associations in the one district visited, he will afterwards be able to carry out similar modes of investigation and association in any other area he may visit.

The above comparison of 'plan' with 'map' brings out the truth that geographical detail can only be thoroughly understood by means of a slight acquaintanceship with the geological structure of the district. This knowledge need not be very profound, but, so far as it goes, it must be correct. The material for the necessary geological knowledge is to be found in the 'Memoirs' published by the Geological Survey of England, and a fairly full summary, written in a popular style, and fully illustrated, is to be found in Prof. Ramsey's book entitled 'Physical Geology and Geography of Great Britain.'

Vertical Sections and Plans.
(a) Rocks in basin shape beneath London.

With a class of fairly intelligent pupils and a district of regular and simple geological structure a successful attempt may be made to find reasons for the changes of rock material indicated in the map and plan just described.

A glance at the section Fig. 3 is sufficient to show the basin-like arrangement of the strata beneath London. If the upper line of this section be followed from the Thames to the North Downs at Caterham the same succession of rocks as those on the plan, Fig. 2, will be passed over.* And, if this upper line be followed until Tilburstow Hill is reached, a further series of rocks come under notice, viz., (1) the Greensand, (2) the Gault (clay), (3) the Folkestone sand, and (4) the Hythe beds. The examination of this section enables the pupil not only to determine the order in which each structure of fresh rock material comes into view, but it enables him to recognise the still more important truth, viz., that the entire series of different strata which appear on the surface and which give variety and beauty to the southern surroundings of London, are entirely due to the bending of the strata beneath and near London into this basin shape. Were the strata horizontal, with, for instance, the London clay as the uppermost member of the series, the surface aspect would resemble (throughout the entire area) that of the flat district between the Crystal Palace and Croydon.

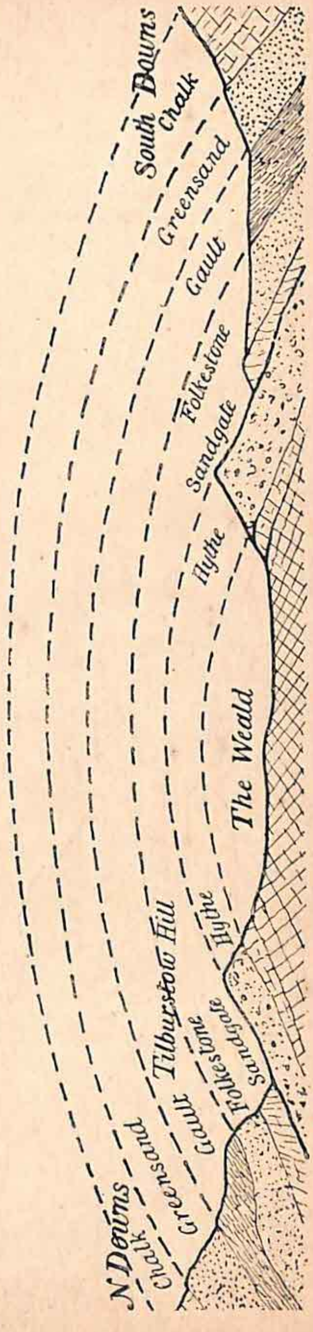

FIG. 4.—Section showing the connection which formerly existed between the North and South Downs.

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* This association of rocks in the vertical section Fig. 3, with the same rocks on the surface and shown on the plan Fig. 2 must be firmly made.

(b) Arrangement of rocks formerly existent in dome-like shape across the weald.

As it is intended to apply the knowledge gained during the actual tour in explanation of geographical features of neighbouring and more distant districts, a further section, Fig. 4, is now examined. The dotted lines show the connection that existed ages ago between the strata followed in the previous section with the same set of strata now found thirty miles to the south in immediate connection with the South Downs. An attempt is made, in imagination, to bridge over the old Wealden area by replacing the strata which have disappeared in consequence of long ages of weathering. It is now recognised that in the distant past there were not two ranges of chalk Downs. One range much higher than either of the present Downs then existed. A very puzzling geographical phenomenon (viz., that of the flow of the Mole and Medway through the North Downs and that of the Arun and Ouse through the South Downs) can be accounted for by means of the knowledge which the section illustrates. This phenomenon will be mentioned and explained in the field.

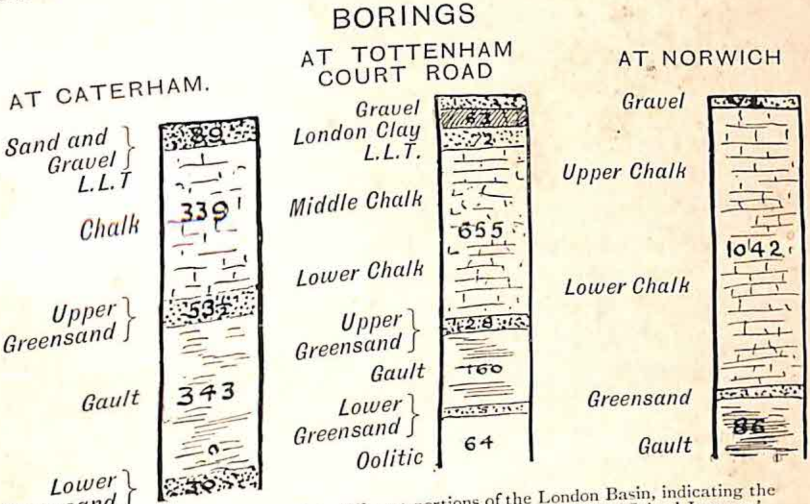

Fig. 5.—Three well-borings sunk in different portions of the London Basin, indicating the existence beneath London of the formations walked over during the 'School Journey.'

Sections of well-borings sunk in the London Basin.

The three well sections here shown should be noted. They indicate the existence, beneath London, of the different strata shown in Fig. 3, and one boring (that at Caterham) shows the presence on the top of the chalk of over 80 feet of sands and gravel. This latter fact, viz., the existence of gravel on the top of the chalk summits accounts for the preservation of the hill tops round that beautifully picturesque locality. It is to the presence of the gravel upon the chalk that the charming variety of scenery round Caterham is due.

Pupils who have thoroughly mastered these maps and sections will be able to understand the instruction subsequently given in the field. Without this preliminary instruction surface appearances may be noted, the variety and charm of the scenery may be enjoyed, but the deeper meaning, *i.e.*, the causes giving rise to the observed geographical phenomena cannot be understood.

Summary and Revision. The class-room preparation for the School Journey is completed by the revision of the facts stated below and the establishment of the truths which the account of the facts illustrate:—

(*a*) That variation in surface contour is usually accompanied by variation in rock structure. For example, the three hill ranges marked on the map are connected directly with changes in the rock structures of these respective ranges: the hills beyond Croydon with the appearance of the Tertiary sands and gravels: the North Downs with the chalk rocks: and the ranges at Tilburstow with an appearance from beneath the gault clay of the sands and sandstones of the Hythe Beds.

(*b*) That some rocks tend to weather into flat districts, whilst other rocks when they spread over the surface become gently curved. For example, all clay areas tend to become flat, whilst limestone and sandstone districts become undulating and hilly respectively.

(*c*) That *strikingly* undulating and picturesque areas (as at the village of Caterham) derive their variety of outline from the presence of a considerable variety of rock structure in close proximity, *e.g.*, the chalk hills near Caterham village are capped with the gravels and sands of the Croydon area, the summits being thus preserved whilst the sides only are subject to weathering. Steeper hill slopes are thus produced.

(B.) SCHOOL JOURNEY BY RAILWAY.

Introductory. The object of the preceding chapter was to set out in detail a method of class instruction preparatory to attempting a 'School Journey.' The general structure of the rock strata beneath London and their appearance, in order, on the surface in the adjoining country districts was explained—special use being made of maps, plans, and vertical sections, for the purpose of making this structure understood. I now

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proceed to describe the use made of this preparatory knowledge during the excursion itself. As the first portion of the exercise is by railway, it may be well, at this stage, to show how the railway journey may be utilized for purposes of geographical study. So many children are now taken by railway to seaside or other resorts, that an attempt might, with advantage, be made to make these journeys of more educational value than they are at present.

The Use of Maps, Plans, and Abstracts during the Journey.

Before starting by train each pupil is provided with a brief abstract of the facts taught during the preparatory instruction in school. This abstract is appended to the present chapter and is printed on pp. 25 and 26. The maps and sectional plans already described accompany the abstract. Unless these maps and plans are provided there is not much hope of really valuable work being accomplished during the railway portion of the journey. The maps, &c., tend to fix the pupil's observation upon the essential points in the different views which somewhat rapidly pass before him, instead of allowing some incidental but trivial feature to divert his thought.

When the actual journey has commenced the teacher may with advantage be present. He should be ready and even anxious, to answer any enquiries his pupils may make; but I think it unwise to turn the railway compartment into a lecture hall. The scholar should, as far as possible, be encouraged to make his own observation. The sense of ability to recognise (in the view before him) some geographical feature learned in the class-room will prove a great pleasure and stimulus. It will be well not to rob the scholar of this pleasure by telling him everything. There is guidance, however, which is quite admissible during this portion of the journey. It would be well sometimes, for instance, to point in a certain direction and ask the scholars to state what they observe. It would be better, however, to get them to compare the district now in view with one just passed, and it would perhaps be best of all, now and then, to ask a question like the following, viz.: Look at your maps and state the kind of country you expect to reach in a few minutes?

The feeling of satisfaction with which a scholar views the changes of natural aspect which he has successfully anticipated is ample reward for the effort he makes. There need be little or no fear that this effort to learn during a railway excursion will rob the journey of any of its pleasure. Indeed a fresh charm will be added to railway riding when scholars are thus induced either to interpret at first hand the map, or, by right use of the map, to anticipate the approaching changes in the surface appearances of the district over which they are travelling.

The Railway Journey from London to New Cross.

This portion of the journey yields least opportunity for geographical study. Mile after mile of houses is passed, the aspect being varied only by the appearance of either a church, a factory, or a Board School. The railway runs, for the most part, upon arches built above the level of the house tops. Ships can be detected either in dock or on the river on a level with, or even above, the houses. The few spots yet unbuilt upon present the remains of what were once very productive market gardens, yielding vast supplies of rhubarb and celery. The soil is a very dark loam, produced in part by the overflowing of the river, and in part by the vegetable débris brought down from the higher region, soon to be discussed. A passing reference to the banking in of the lower reaches of the Thames by Dutchmen during the reign of William and Mary may be made. The knowledge gained by these Dutchmen during similar operations in Holland proved of service in the effort to keep back the high flood tides of the Thames. A contrast may also be made between the old clay and mud banks of the river at Deptford and Greenwich, and those faced with Portland stone between Westminster Bridge and Blackfriars.

It may be objected by some that these Dutchmen and their work, and the contrast of their work with that of similar work done to-day, has little or no connection with the 'School Journey.' The 'School Journey,' they urge, is to cultivate directly the observing powers of the scholars. True, the observing powers are primarily to be engaged; at the same time the powers of reflection must be aroused. Every observed phenomenon should be surrounded, as far as possible, with allied matter, and, if possible, traced back to its cause. In the case of the overflowing of the Thames and the enclosure of the marshes by Dutch bankmen, the association is partly historical and partly geographical. In future paragraphs other associations will be made. It is the object of the 'School Journey' not only to help children to see, but especially to stimulate enquiry into the reasons of what is seen.

Railway Journey from New Cross to Croydon.

Reference to the map shows that the railway enters the London clay area soon after leaving New Cross Station. The accompanying photograph is a view taken from the side of the railway. It was taken by a youth who has been more than once amongst the class of enquirers after knowledge by means of the 'School Journey.' He knew well the spot best fitted for the purposes of this article; and, in order to get the most suitable light for photographic effects, was in the field very early one morning in June of this year.

(I mention this to show that a permanent interest in nature and in natural scenery is almost sure to follow a thorough enquiry into the geographical conditions of any one carefully-selected district. With but two exceptions, all the photographs prepared for this and the following chapters have been obtained from old pupils who have developed their love of natural scenery whilst participating in the School Journey.)

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Observed Tendency of Clay Districts to Weather into flat areas.

Along the banks of the railway cutting in the neighbourhood of Honor Oak Park (Fig. 6) a slope of about 30 degrees was originally cut by the railway contractors. This slope was at first smooth and regular. To-day the smoothness and regularity of the slope has entirely disappeared, and the constant tendency of the clay to slip irregularly towards the lower level of the railway is manifested. In the photograph (Fig. 6) this slipping tendency is most clearly developed between the first and second of the telegraph posts nearest the metals. The scholars who pass this district in the train have a much clearer view of the irregularities in the clay (due to natural slipping) than can possibly be shown in a photograph. The means taken by the railway authorities to prevent further slipping are also very evident. In some cases strong brick walls have been built to hold up the clay. In other areas deep trenches at right-angles to the direction of the metals, and reaching from the top to the bottom of the slope, have been dug at regular intervals. These are then filled with chalk or other binding material in order to prevent further slipping down of the clay.

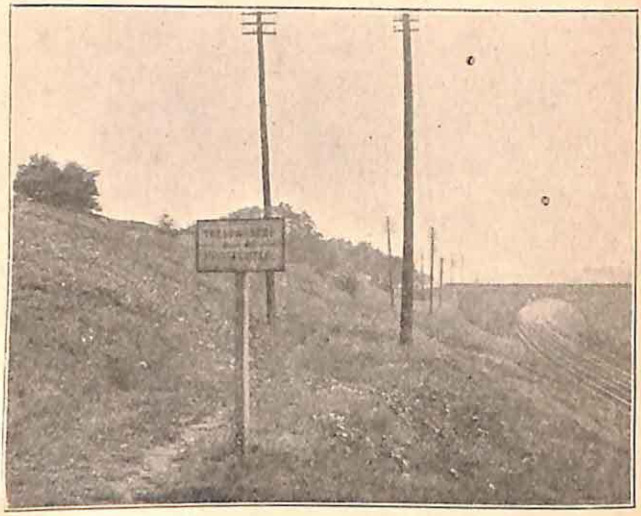

FIG. 6.—Showing the tendency of clay to slip, and thus to render a level aspect to the surface. By Mr. Leslie Cowham.

Example of Reasoning Based upon above Observations.

So far the scholars have been led to observe facts for themselves. They may be told of other districts where similar conditions are observed. For example, along the Great Northern Railway northwards from King's Cross, beyond the Alexandra Palace, the clay embankments constantly tend to slip into the cutting and to level up the line. What use should the scholars now make of the facts observed and stated? It ought not to be difficult for an intelligent youth to form such simple reasoning efforts as the following, viz.: 'Clay tends, by slipping, to fill up hollows'; 'By filling up adjacent hollows a clay district tends to become flat'; 'Whenever, in travelling over a new district, a plain-like flat area is reached, it is very probably composed of clay.'

Journey through Norwood to Croydon.

After passing a series of clay cuttings, the journey is continued beyond Forest Hill and Norwood Junction towards Croydon. This district is almost entirely composed of a clay subsoil, and is consequently very flat. After passing through the station at Croydon the surface immediately becomes undulating. A cutting of the railway passes through the hills of gravel and sand which rest beneath the clay already mentioned, but which at Croydon appear at the surface, and form the ridge of high land known as the Shirley and Addington Hills. The photograph (Fig. 7) taken from the railway beyond Croydon, shows this range of tertiary hills.

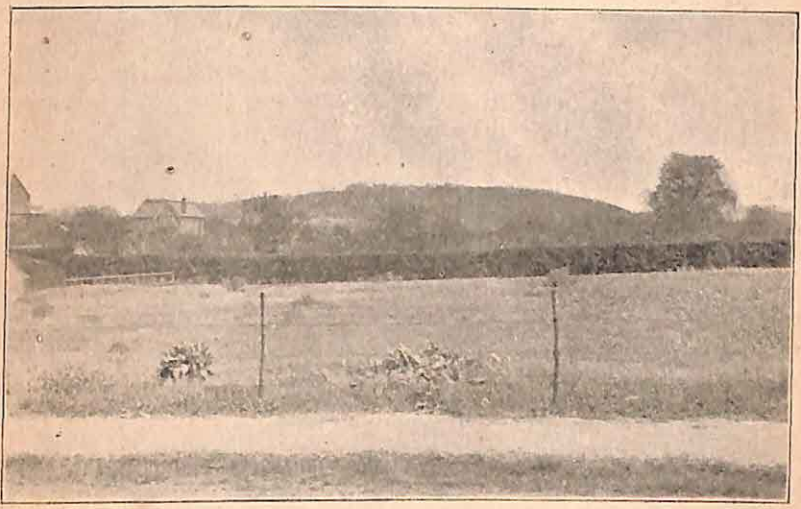

FIG. 7.—The Tertiary Hills of sand and gravel seen from South Croydon Station. Photo by Mr. Jos. Kay.

After observing the effects of these sands and gravels upon the surface aspects a contrast may be made between the 'clay' effects and those of the 'tertiaries.' These effects will be seen to be almost entirely opposed to each other. Whilst clay weathers flat, a mixture of sand and gravel weathers into a beautifully varied and undulating district. The slope of a railway cutting in the sand and gravel may be almost vertical, but in the clay it must be very slight and gradual. Such

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contrasts as these the scholars must be encouraged to make with very little help from the teacher. They may be fixed in their memories by asking the pupils to make drawings of sections across the line of railway in clay and sand districts respectively. Fig. 8 represents the drawings here suggested.

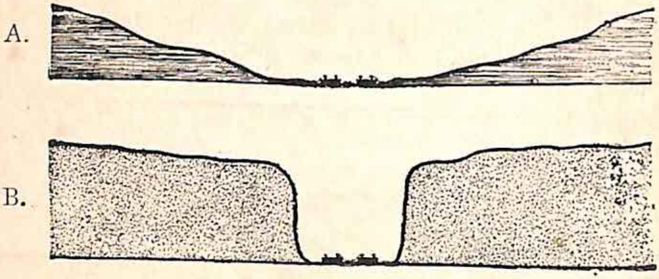

FIG. 8.—A. Section across the railway in a clay cutting.
B. ,, ,, ,, in a sand cutting.

Change from the Steep Hill Slopes of the Tertiaries to the gently undulating surface of the Chalk.

The tertiary hills beyond Croydon are quickly passed through by means of a very steep-sided cutting. The scholars cannot fail to observe the contrast between the slope at which these sands and gravels rest and the slope of the clay. The gently undulating and almost treeless surface of the chalk Downs is soon reached, and the contrast in surface appearances between the new district and those already traversed

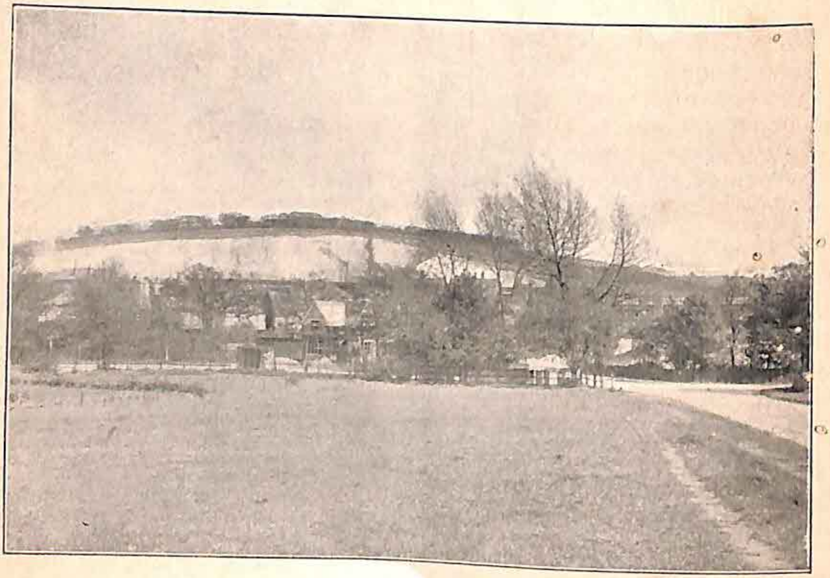

FIG. 9.—A Chalk Quarry at Purley Station showing the rounded surface outline of the chalk.

is now very striking. The teacher may ask the scholars (as they pass along) to point out, if they can a single square yard of level land or level yard of path. When Purley station is reached the white glare from the face of the chalk quarry makes the change from the sandy soil near Croydon very marked. The upper outline of the quarry (seen in photograph Fig. 9) is characteristic of all chalk-face areas. This rounded outline continues to distinguish the remaining portion of the railway journey until Caterham is reached.

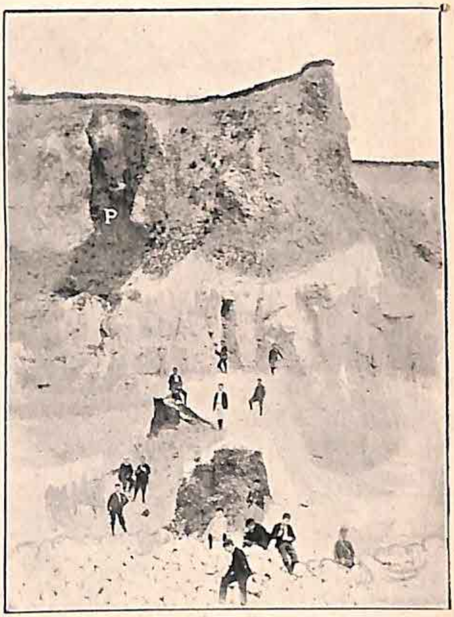

FIG. 10.—The chalk quarry at Purley. The dark patches marked P are sand and gravel. Some of the pupils are making their way up towards the sand.

At Purley, about two and a half miles south of Croydon, the pupils change trains. The stop affords an opportunity of examining the chalk quarry which immediately faces the railway station. The piled up section of dazzling white chalk and the rounded outline of the grassy upper surface at first engross attention. The masses of red sand and gravel which, in patches, appear to disfigure the otherwise pure white surface of the chalk, soon, however, attract notice. In reply to the pupils' questions these patches of sand are accounted for in the following way.

Upon examination the sands and gravels prove to be the same as those left behind at Croydon (the Lower London Tertiaries).

What do these detached masses suggest?

Several attempts to answer are made.

At last a pupil ventures to state that 'the patches of sand are evidence of the extension of these rocks over the chalk to the quarry under observation.'

This is the correct answer to the query.

Another question is now started, viz.: 'What has severed these outliers of sand from the main mass of the Tertiaries'?

'Weathering' is the unanimous response.

The scholars are exhorted to watch for evidences of the existence of other outliers of a similar kind.

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The attention of the scholars is called thus prominently to these sands for a reason which will be apparent later on.

So far the railway journey has brought before the scholars three distinctly marked surface appearances, viz.: (1) the flat clay area of Norwood Junction, (2) the steep hill slopes of the sand and gravel district south of Croydon, and (3) the gently undulating outline of the chalk downs at Purley. The surface appearances have been furthermore associated with the underlying rock material. If the reader will take a map of England and draw a line from the mouth of the Tees to the bay of Lyme Regis he will have an area to the south-east of this line very largely composed of one or other of these three rock formations. The surface appearances over this entire area change with the change in the underlying rocks in the manner our 'Railway Journey' has enabled us to indicate to our pupils in the above sketch. Thus, a journey of a few miles becomes the means of an intelligible interpretation of the surface appearances over an area equal to that of half of England.

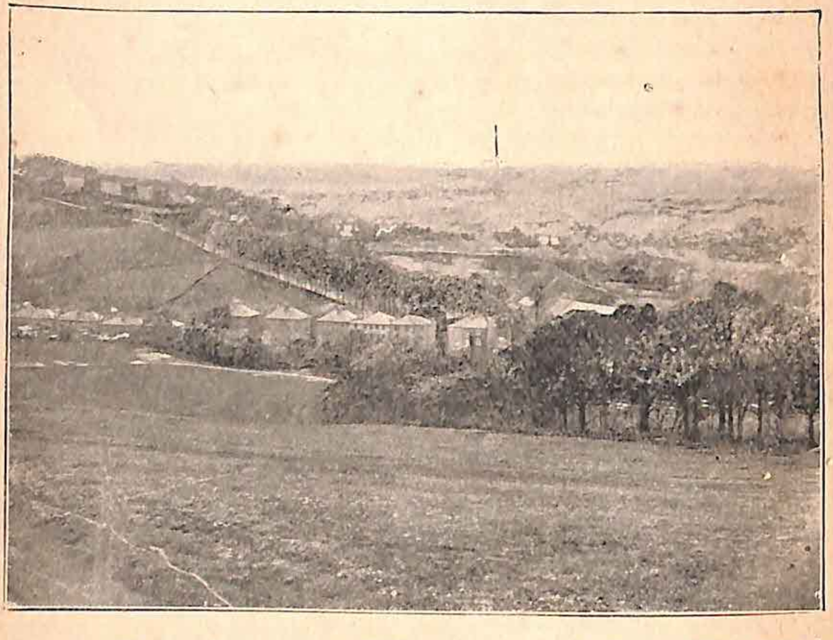

FIG. 11.—Showing the tree-crowned hills and well-wooded vales round Caterham.

The photograph (Fig. 11) with which this chapter closes shows the beautifully picturesque region into which our railway ride of about fifteen miles has brought us. We must reserve for a further chapter any attempt at complete explanation of the panorama which is spread before the delighted gaze of the scholars.

COPY OF ABSTRACT

To be placed in the hands of each pupil before commencing the 'Journey by Rail.'

In the following abstract the reader will notice a repetition of many of the facts taught in the preceding chapter. This abstract is accompanied by drawings of 'map' and 'plan' of the route, also of the vertical sections in Chapter I.

From Charing Cross to New Cross :—

(*a*) Notice the low and almost monotonous level of the country. The railway running almost continuously over arches above the level of the houses.

(*b*) Observe the shipping on the Thames and in the Docks apparently at a higher level than houses.

(*c*) Where possible, catch a view of the soil and notice its dark rich colour.

(*d*) From (*b*) and (*c*) infer that before the Thames was embanked it would overflow these low-lying districts.

(*e*) Connect the rich alluvial deposit with garden produce for the supply of the town markets.

A passing reference suffices to connect the embankments with the Dutchmen who undertook the work. An association may at the same time be made with similar districts in Holland and in our own Fen country.

From New Cross to Croydon :—

(*a*) Observe the change in the level of the country as indicated by the railway enclosed between embankments.

(*b*) Notice the width of the cutting on either side as at Honor Oak Park Station.

(*c*) Connect this width with the tendency to slip observed whenever cuttings are made in clay.

(*d*) Observe the efforts of the railway companies to prevent the clay filling in the cutting—by walls and trenches filled with chalk.

(*e*) If the clay be left without these protecting walls the railway cuttings would fill up. The tendency of clay areas to become level and plain-like is thus illustrated.

(*f*) After leaving Forest Hill, the district through Norwood Junction to Croydon exhibits all the appearances of a very extensive clay plain.

From Croydon to Caterham :—

(*a*) Notice the change in the appearance of the country immediately after leaving New Croydon—from flat to hilly, the railway embankments becoming almost vertical.

(*b*) Catch a view of the gravel quarry on the right, and the patches of almost pure white sand along the embankment on the left.

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(*c*) After leaving South Croydon, look backwards on the left-hand side of railway and see the beautifully wooded and steep gravel-topped hills of Addington and Shirley. These must be connected with the change from clay on the north of Croydon to the sand and gravel on the surface south of Croydon

(*d*) From South Croydon to Caterham the country again changes its surface aspect. No steep hills, no level plains—the entire country becoming gently undulating. Look into the fields and try, if possible, to find a square yard of perfectly level land.

(*e*) At Purley Station notice the "outliers" of Lower London Tertiaries.

The above enumeration of things to be noted, arranged somewhat in tabular form and unaccompanied by views or diagrams, may strike the reader as little likely to impress the young traveller. It should be observed, however, that the carefully prepared pupil has already in his class-room exercise formed a series of pictures of the country to be passed over. These pictures are purely mental, being arrived at mainly by processes of imaginative effort. The interest, however, with which the pupil compares his mental images with the observed facts is very striking. Whilst passing over the housetops towards New Cross he frequently manifests impatience at the delay in arriving at the slipping clay. He is particularly impressed when a recent landslip shows how determined the clayey rock is to undo the work of the railway contractor. When the hills beyond Croydon are reached his delight at seeing the well-wooded sand and gravel slopes is intensified by his effort to connect these with similar sands and gravels more than twenty miles away on the north of London. When, furthermore, he turns to his well-sections, Fig. 5, and realizes the truth that these sands and gravel rest everywhere beneath the streets and houses of London, and are only hid from view by the thick covering of London clay, his pleasure at seeing these surface representations of widely extended rocks is evident. The open and breezy 'Downs' between Croydon and Caterham afford a sufficient contrast with both districts over which he has previously travelled to awaken interest and maintain it.

The contrast between the attitude of pupils thoroughly prepared for the journey by class-room instruction and a party of youths travelling on an ordinary school-treat or excursion with no preliminary instruction is most marked. Even an ordinary map placed in the hands of a youth when taking a railway journey adds materially to the interest he takes in the country over which he travels. A youth who has been prepared so that he has a fairly full prior knowledge of the special features that form the chief objects of his observation is somewhat in the position of the traveller who visits, for the first time, a country about which he has taken a lively interest, and of which he has already, in imagination, become familiar by means of the graphic accounts of which he has either read in books, or, better still, of which he has heard from those who have visited the area before him.

(C.) THE WALKING TOUR.

The walking tour completes the school journey. It may be suggested that instead of completing the journey the walking tour ought to begin it, and that class-room explanation should follow. This latter plan appears well in theory. In practice, however, I have found that natural phenomena, as these are viewed in the field, are so varied and complex, and their arrangement is on so vast a scale, that the observer is in danger of becoming either bewildered or disheartened. If a group of scholars having no previous instruction, be taken to the top of the hill overlooking the village of Caterham from the south, they will view the landscape before them with intense delight. 'Grand, isn't it?' says one. 'Nothing finer in Surrey,' says another. Such expressions as these will be repeated in various forms, but, beyond such exclamations very little will be heard. The pleasure felt in allowing the eye to rest upon a varied surface outline of great expanse, upon hills wooded to their summits, and upon dales mantled in richest verdure, is all sufficing. The pupils' language betrays their satisfaction. They resent, rather than desire, the teacher's instruction.

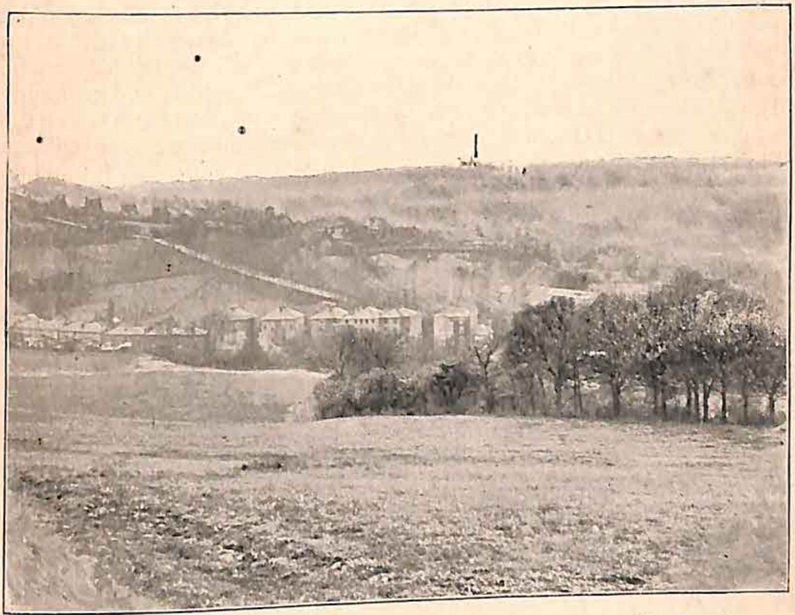

FIG. 12.—View over Caterham from hill on the left of the road leading to Godstone. The tower on the sky line is a shaft immediately over the Caterham boring.

Compare with this the behaviour of youths who have brought with them the knowledge detailed in the previous chapters! They rest for a few moments on the hill side and quietly enjoy the panorama before them. They are not content, however, with simply seeing and enjoying.

'Why this change from the flat aspect near Norwood and the regular undulations of the grass-covered "Downs?"' is the first enquiry.

The question serves to indicate the trend of the scholar's thoughts. As yet, however, their knowledge is not sufficient to hazard a reply. The teacher at once proceeds to supply the required knowledge. He points to a high shaft on the top of the opposite hill. Immediately below is the boring of an Artesian which supplies the valley with water. The plan of the boring (Fig. 5) is now examined. It is there shown that over 80 feet of sands and gravels cap the summit. The hill on which they rest has a similar gravel top. The surrounding hills are all similarly capped. It is now the teacher's turn to ask a question. It takes the following form:—

'You remember the hills at South Croydon, and the "outliers" at Purley. These were formed of sand and gravel. The gravel preventing the tops of those hills being washed away. The same sand and gravel is found on the tops of all the surrounding hills. What is the cause, think you, of these hill tops being preserved whilst their sides are worn into the deep valleys before you?'

The scholars have little difficulty now in connecting the height of the hill, the steep slopes into the valleys, and the heavily timbered summits of the hill tops, with the presence there of the sand and gravel. The association of variety of rock structure with variety in slope is now firmly made by the class. It will prove a principle capable of application in almost every locality they visit. If asked to enumerate other hill structures near London the same truth is illustrated.

One mentions 'Hampstead Heath.'

'Yes,' says the teacher, 'the top of the hill at Hampstead is protected by a sandy deposit called the Bagshot beds.'

Another pupil suggests 'Beddington.'

Here again, an outlier of sand is the cause, but the sand in this case is that the scholars saw in the cutting near Croydon, viz., the Thanet sand.

A third suggests 'Shooter's Hill.'

Again a gravel outlier rests on the top and prevents the hill being worn down.

Lastly, a pupil suggests the high land on Clapham, Wandsworth, and Wimbledon Commons.

In each case, it is stated that the level of the Common has been preserved by a gravel deposit—the gravel on the commons being a deposit of the river when it flowed at a much higher level.

It may be objected that the matter now being taught does not come under notice in the journey, and that other matter immediately under the eye of the scholar is being overlooked. Just so. The skill of the teacher is best shown in fixing the attention of his class mainly upon those features in the journey capable of widespread application. Scholars rambling unguided may observe more detached matter than those who are under skilled direction. The former, however, gain less knowledge than the latter. Isolated and detached facts are almost valueless. The best results of the school journey consist of **a few truths strikingly illustrated and widely applied.**

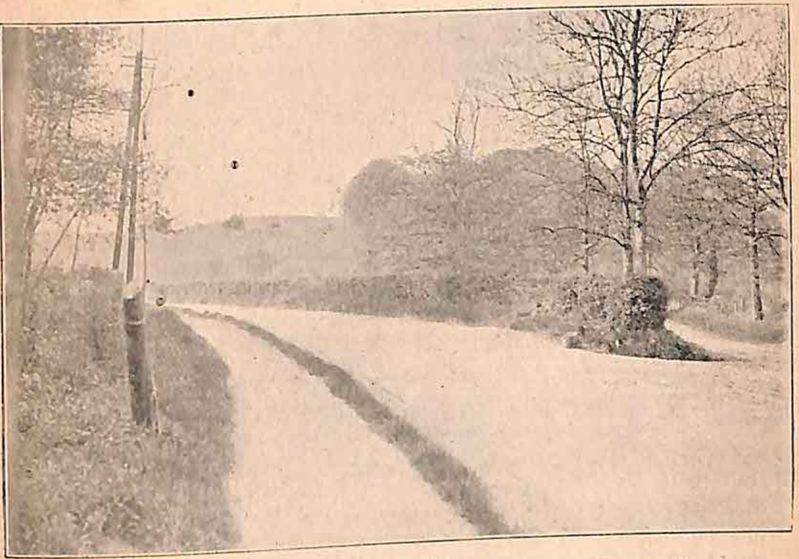

FIG 13.—Near View of rounded surface of Chalk areas. The road makes a gradual ascent towards the top slopes of the 'Downs.' The trees on the right side of the Photo are rooted in the gault clay. Photo by Mr. Kay, Westminster Training College, S.W.

The journey over the Chalk Downs and its lessons.

The scholars descend the hill and join the road leading to Godstone. For the next mile the ramble is over the chalky downs (Fig. 13). The gentle undulations of these treeless areas at once strike the attention. This feature is impressed by the contrast made with the scenery at Caterham (distinctly hilly), at South Croydon (hilly) and at Norwood Junction (flat). Asked whether they have seen similar surface areas in other districts, the pupils are ready with abundant replies.

'Brighton near the dyke and race course.'

'Eastbourne near Beechy Head.'

'Margate and Ramsgate near the North Foreland.'

'Dover at Shakespeare's Cliff': answer different scholars in turn.

They are ready, furthermore, to remind the teacher that in all cases the appearance is associated with the chalk subsoil.

The teacher now takes the scholars further afield, and reminds them that Salisbury Plain in the South is in appearance like the view before them: that the Downs finely developed in the neighbourhood of Hunstanton and spread over the North of Norfolk, are also of the same surface aspect: and that the Lincolnshire and Yorkshire Wolds present the same appearance, and for the same reason. A stretch of imagination, aided by a diagram enables the class to realize the appearance of the mountain masses forming the great Pennine axis of the six Northern Counties. They are told that the highest portions of the extended range are a limestone somewhat harder than the chalk. The likeness however between the surface outline of the Downs and Wold in the South and East of England and that of the Pennine slopes is very marked. The wider general truth is now within reach of the class, viz., **Limestone areas weather so as to present a more or less monotonously curved surface outline.**

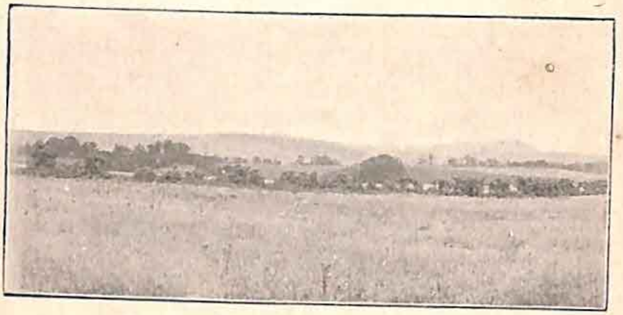

FIG. 14.—The Downs seen from a distance of three miles. The long undulations of these chalk areas are seen on the sky-lines. The flat district in the front of the photo is a clay plain. Photo by Mr. Leslie Cowham.

Before leaving the Downs a further and closer association existing between the above mentioned Downs and Wolds is attempted. Hitherto the association has been two-fold, viz., that of surface outline and of composition. An attempt (and with fairly intelligent scholars a successful one) is now made to show that the series of Downs and Wolds have a common origin.

Extension of Chalk beneath London :—

(*a*) *Extension beneath London.*—Attention is now directed to the chalk range of hills on which the scholars are resting. The thickness of the chalk beneath them is 339 feet (see boring beneath Caterham, Fig. 15); beneath London at Tottenham Court Road it is 655 feet thick (Fig. 15).

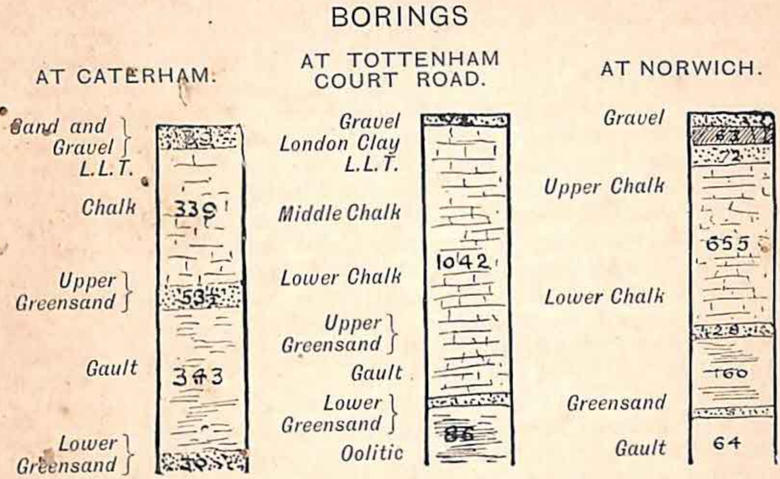

FIG. 15.—Three well-borings sunk in different portions of the London Basin, indicating the existence beneath London of the Chalk formations walked over during the 'School Journey.'

This chalk formation passes out of sight near Croydon, five or six miles away, but it does not stop at that point. Tell the class that besides the three borings shown (Fig. 15), there are twenty others in the London area which all show the existence of chalk beneath the surface. Finally, add the fact that exactly the same chalk rock comes to the surface in the Middlesex Heights at St. Albans, Hatfield, and Hitchin. With these facts clearly before them the scholars should be able to state that whilst geographers look upon the Middlesex Heights and the North Downs as separate and distinct features, *they are really one and the same rock-mass, and were originally one and the same deposit.* (Fig. 16A illustrates this notion).

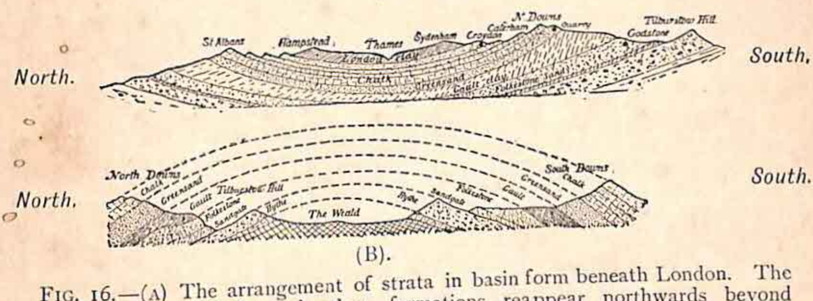

FIG. 16.—(A) The arrangement of strata in basin form beneath London. The chalk and other formations reappear northwards beyond Hampstead and St. Albans.

(B) The 'dome-like' arrangement of strata (anticlinal) over the Sussex Weald now removed by centuries of weathering.

(*b*) *Extension of the Chalk over the Weald.*—The scholars are now asked to turn their attention in the opposite direction from that of the view (Fig. 12). They see immediately in front the long surface undulations of the North Downs scenery. They turn half round, and, looking directly south, are told to try to make out a line of very dim hill-forms on the sky-line some thirty miles southward. Only on rare occasions, *i.e.* on remarkable clear days, are these visible. The scholars are referred to Fig. 16B. This will help them to understand the somewhat difficult problem before them. The dotted lines in that figure represent the former extension of the chalk southwards in an upward curve, and the connection which once existed between the North and South Downs.

Questions to be asked and answered.—Care must be taken with young pupils not to proceed to too many new ideas at once. Questions like the following help to fix the facts already taken :—

1. What chalk ranges exist north of London? *Ans.* The Middlesex Heights.

2. What evidence have we that this chalk range is connected with the North Downs? *Ans.* By tracing the chalk strata beneath London on Fig. 16A.

3. Think for a moment, and then tell me, if you can, why these surface chalk ranges are now separated?

(If this question be not answered, it would be necessary to help the scholars to a reply. The chalk mass was covered by the sands and clays already mentioned. Both were then bent into a basin-shape, and so, whilst the upper curves of the chalk are exposed in the Middlesex Heights and the North Downs, the intervening chalk masses are preserved).

4. What hills in the far south of England were once connected with the North Downs? *Ans.* The South Downs.

5. What has separated these two ranges of Downs?

(Fig. 16B suggests the reply. A fairly clever boy will see that the elevated mass would be exposed to rapid weathering away by rain and river.)

(*c*) *Still wider extension of the Chalk area.*—If the class be sufficiently advanced to attempt still further connections of the hills on which they stand, they may be told that the chalk ranges, which stretch from the Middlesex Heights in a long range towards Hunstanton and Norwich, form another basin, like that beneath London. This time, however, the strata bend beneath the Wash and the low-lying Fens and reappear in the Lincolnshire and Yorkshire Wolds, terminating in the region round Flamborough Head. Leaving the North of England for a moment and turning to the South Downs, the scholars may be told that these also bend beneath the South of Hampshire and reappear in a ridge crossing the Isle of Wight from Culver Cliff in the east to the Needles in the west This is not a new notion. The bending of strata into basin-shape is familiar. Three of these basin areas have already been discussed in this chapter—one is immediately in view, the other two become known by the exercise of the constructive imagination of the learner.

Influence of this teaching upon the Scholars' geographical knowledge.

In future the Yorkshire Wolds, the East Anglian Heights, the North Downs, South Downs, and the Isle of Wight Hills will not be learned as isolated geographical facts. They will be recalled as different portions of one and the same chalk-mass, but now detached because of the downward (or basin) and upward (or saddleback) curves, into which nature, by the exercise of a mighty internal force, has thrown them. In like manner Flamborough Head, Hunstanton, North Foreland, South Foreland, Beachy Head, Culver Cliff, and the Needles will be closely associated, for they are terminations seaward of the series of hill ranges of one and the same formation.

Geography, Science and Poetry.

The scholars are now impressed with the wide extension of the chalk mass they see before them. A glance at the Norwich boring (Fig. 5) shows a depth of chalk of 1,000 feet, so that at least this thickness of the deposit was originally made.

The question, 'What made the chalk?' naturally arises, and might be asked. A prepared microscopic slide, with chalk forms upon it, and a pocket-magnifier suffice to show the shells (tests) of the tiny agent, and thus the question, 'What made?' is answered. The class is told that the same tiny living forms are to-day slowly accumulating masses of similar shells (tests) at the bottom of the Atlantic and Pacific Oceans. Allow the class to ponder over the facts just presented, and then ask the following questions:—

1. Was the area extending from Flamborough to Purbeck sea or land when the chalk masses were deposited? *Ans.* Sea.

2. How has the chalk deposit been changed from deep ocean bed to the high land on which you stand? *Ans.* By elevation.

3. During the process of elevation, was the chalk mass lifted evenly or was it curved? *Ans.* Curved into basin and dome-like curves.

4. In what areas of England is the chalk preserved in basin-like curves?

5. Name an area from over which the chalk has been washed away?

6. Direct the attention of the class to the dust that has collected on their feet, and quote the line—

> 'The dust we tread upon was once alive.'

And ask any boy to explain it.

The journey across the Chalk Downs is completed by a walk of about three-quarters of a mile. The pupils notice as they walk along that no portion of the road is perfectly level. A rather sudden change in the inclination of the path marks the transition from chalk to Greensand.

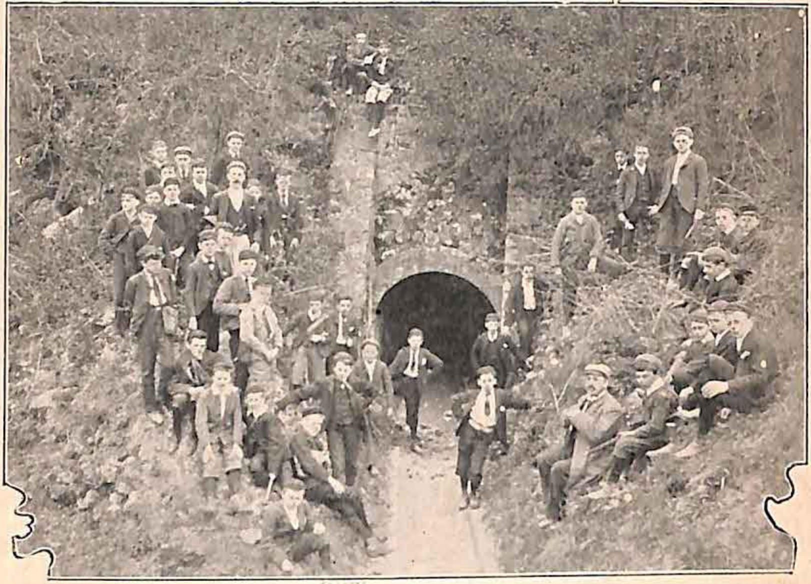

FIG. 17.—The entrance to the Greensand Quarry. Pupils assembling before entrance. Photo by Mr. G. G. Lewis, Bellenden Road Higher Grade School.

The Greensand – A Journey Underground.

The intellectual strain of the last half hour is now relieved by entering a Quarry (Fig. 17) having the appearance of a long railway tunnel. After groping along for about three-quarters of a mile, the class reaches the workings. They are now 300 feet below the Chalk Downs upon which they first rested.

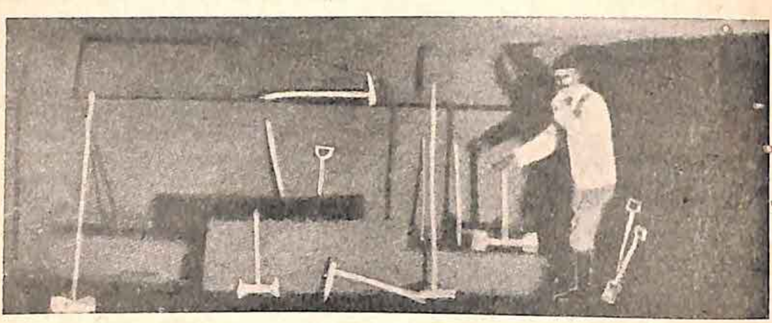

FIG. 18.—At work in the Greensand Quarry near Godstone. Photo by J. A. Carter, Esq., B.A., Reedham.

The flash-light photograph of this quarry, taken by J. A. Carter, Esq., Reedham, shows the workman at the end of this long underground tunnel (Fig. 18). The head of the quarryman nearly touches the roof, and the width of the quarry is very little more than the height. This underground journey, with its gentle slope downwards, gives the scholars a clear notion of slightly-curved strata. If they consult Fig. 16A, Fig. 16B, and the three borings, Fig. 15, they will readily answer the following questions:—

1. If continued far enough, where would this tunnel in the greensand end?
2. What would be the depth of the tunnel beneath Tottenham Court Road? (*See Fig.* 15).
3. Why should the greensand be found to the north of the chalk of the South Downs and to the south of the range of chalk hills crossing the Isle of Wight? (*See Fig.* 16B.)

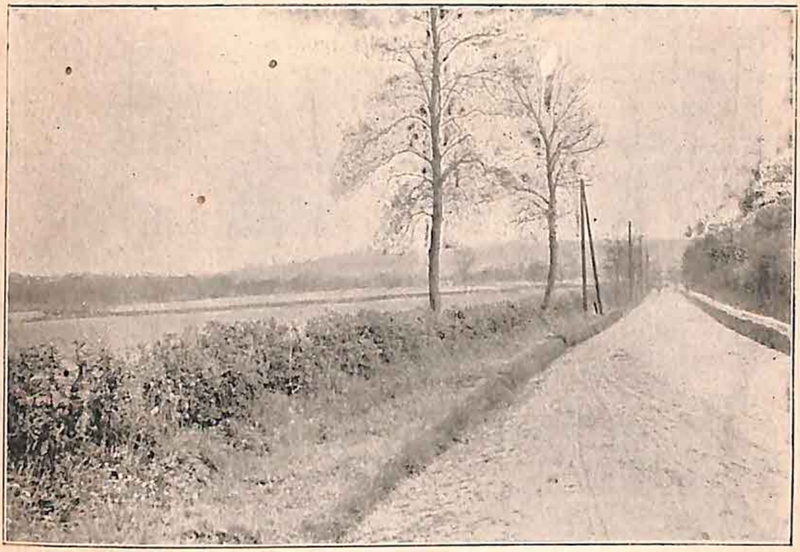

FIG. 19.—Photographic view looking southward over the Gault, with hills of the Lower Greensand on the sky-line. Photo by Mr. Jos. Kay.

Journey across the Gault (Clay).

After emerging from the quarry, the scholars look northwards for a moment (*see Fig.* 13) at the hills under which they have burrowed. They then turn half round, and looking southward, they view a long stretch of almost level ground (*see Fig.* 19).

The class recalls the appearance of the London clay area, and the resemblance between that area and the gault clay region before them is at once recognised. Their attention is now directed to the nature of the vegetation in the fields—rushes, horsetails, and coltsfoot abound. A specimen of the clay is obtained from the road-side ditch. They consult the borings in Fig. 15, and find that the gault clay follows the chalk through the entire distance beneath London. The class (with the knowledge they now possess, and by reference to the two sectional drawing Fig. 3 and 4) can at once state why this clay is found in Huntingdonshire on the north, and in Sussex on the south, and can readily state the kind of surface found wherever the gault comes to view.

A walk of nearly a mile across the flat and rather uninteresting gault affords a necessary brain rest. The class is merely told to make an attempt to determine where the gault clay ends and the sands of the next formation begin. It is both instructive and amusing to see the efforts made by different pupils to solve the problem. Some stop at a sudden dip in the road; others watch the fields to see where the rushes disappear; the position of some cottages and their well-kept gardens attract some, whilst not a few plod on until they come full in view of the silvery sand of the Folkestone beds. The first and second set of observers are to be commended. They have gained the power of acting upon evidence. The last-named observers are, as yet, sure only of that which they see.

The change from heavy clay to bright silver sand.

The view Fig. 20, shows the remarkable change in rock structure which has occurred in the short space of about one hundred yards. The village of Godstone begins where the clay ends; a slight admixture of clay and sand follows the gault clay, and almost immediately the pupils find themselves in the midst of sandstone scenery. A few minutes is sufficient to bring a change from level roads and equally level fields on either side, to a roadway showing a considerable incline, and to fields with undulating surfaces. The explanation is not difficult. A marked feature in the appearance of the face of the sand quarry, Fig. 20, is the thick line of almost pure iron which rests on the top of the sand. This resists the decay occasioned by weathering forces, and hence the hilly appearance of the

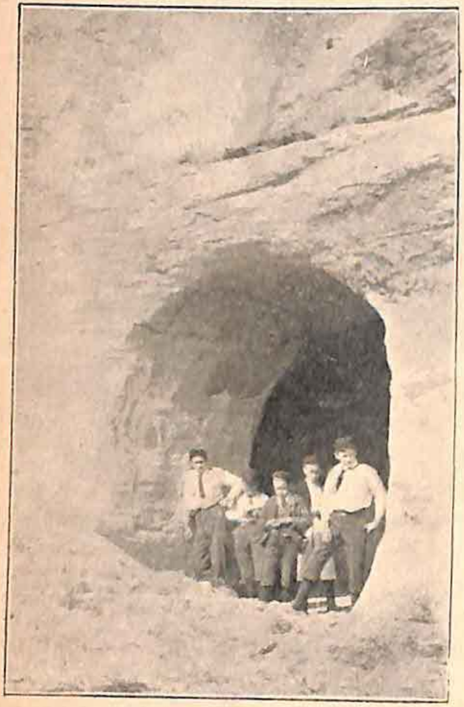

FIG. 20.—The Folkestone Sandpit at Godstone. Pupils returning from an underground journey. Photo by Mr. G. G. Lewis, Bellenden Road Higher Grade School.

surface. As soon as the sand, with its protecting layer of ironstone, is passed over, the surface rocks wear away rapidly, and both road and fields quickly pass into a somewhat steep valley.

Before leaving the sand quarry permission is given the pupils to enter the workings. They are delighted to enter the cool and somewhat dark caverns. They soon, however, return, and, with something like surprise, report the presence of water preventing their progress. The scholars are requested to sit on the dry sand banks of the quarry whilst the following important facts are related.

> A few years ago a London firm, anxious to obtain a supply of pure water, made the boring marked Tottenham, Fig. 5. They bored through the London clay and the sand and gravels of the Tertiaries and also through the chalk and gault, expecting to tap the water held in the silver sand of these Folkestone beds. Their expectations, however, were not realized. These sands were not found beneath the Gault, and hence the water was not tapped.
>
> Why do not these sands extend beneath London in the same way as the other rocks passed over in the ramble from Caterham to Godstone? is a very natural question for the pupils to ask.
>
> In reply, the scholars are taken in memory to the seaside. The sand is known to be a beach deposit. Its formation is proceeding between the limits of high and low water. The range of sand deposit is therefore very limited. Hence it is not surprising to find that the Folkestone sand does not extend so far as either the Gault clay or chalk, both of which were originally found in deeper water and hence might be expected to cover a wide area.

Other questions raised but not answered.

Why is the band of iron stone on the top of these Folkestone sands? asks an observing and somewhat enquiring pupil.

Will you, at the same time, kindly tell the reason why the flints of the chalk are deposited in lines about a yard apart? asks another pupil.

The teacher frankly acknowledge his ignorance and tells his class, that the answers to these questions have not been at all clearly settled, and that nature has a few secrets left for future enquirers to find out.

The moral aspects of a study of elementary science should not be overlooked. The teacher, no doubt, should strive to make himself thoroughly acquainted with the phenomena likely to be met during the 'School Journey.' When, however, he has done his best in this respect, he will rarely find an area in which some mystery or other does not present itself. In such cases, the frank acknowledgment of ignorance on the part of the teacher will be more than compensated for by the regard for truth which his answer evinces.

The Last Hill-Climb—Results of an Earthquake Viewed.

A steady climb of a mile brings the class to the summit of the hills (Tilburstow) seen on the sky line of Fig. 19. The beautifully-varied scenery here is entirely due to the change from clay to a sandstone that is sometimes hard and at other times soft and friable. Turning through a gateway on the left of the roadway, near the summit of Tilburstow Hill, the sand quarry, Fig. 21, is entered. The Fig. 21 and its footnote are sufficiently explanatory of each other. Here at a glance the scholars find themselves in the presence of clear but startling effects of those mighty underground forces already mentioned in connection with the bending of the chalk.

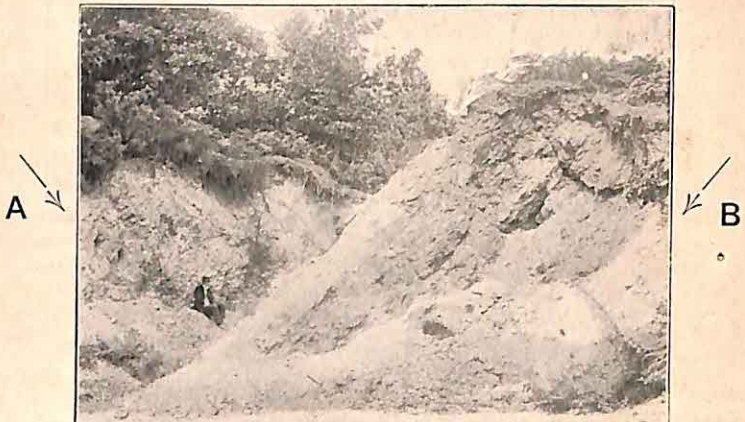

FIG. 21.—Lower Greensand Quarry on Tilburstow Hill. The arrow **A** shows the direction of the bedding on the left. The arrow **B** shows the direction of the bedding on the right. This dislocation of the strata (fault) must have been accompanied by earthquake commotion on the surface. Photo by Mr. Leslie Cowham.

A View over the Weald, an old Geographical notion exploded, and the journey ended.

By means of a climb up the sides of the quarry near B, a view, unequalled in the south of England for beauty and extent, is suddenly spread before the delighted observer. As the scholars look southward over the Weald, they are encouraged to build afresh (by an effort of imagination, aided by Fig. 4), the high dome of land that once covered the entire Sussex Weald, but which has now been washed away. They also connect the sources of the rivers Wey and Mole (which now appear to break through the North Downs) with the summit of this replaced chalk dome, and they are thus led to understand that the valleys through which these rivers now flow are the remains of valleys made ages ago, when the sources of these rivers were upon or near the summit of the dome-like ridge, which has gradually disappeared. The Geographers who wrote text-books thirty years ago were unable to account for the strange phenomenon of a river apparently breaking through a range of hills. An appeal to elementary notions of Geology yields an explanation sufficiently simple and clear to recommend it to the understanding of a class of intelligent youths.

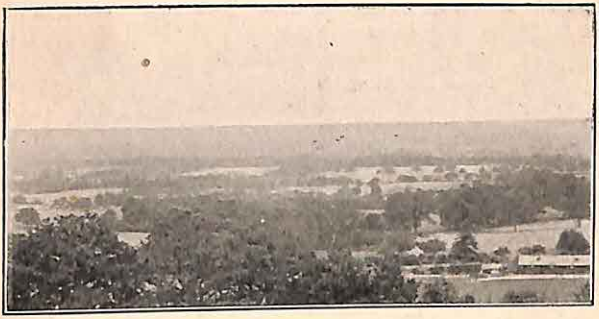

FIG. 22.—View over the Weald. Ranges of hills are dimly visible beyond the flat Wealden clay area. These are the Wealden Heights, whilst still further, and on the sky-line, are the South Downs. Photo by Mr. Leslie Cowham.

After a few minutes' rest on the slope of the hill, with a view of 30 miles to rest the eye, the class is disbanded and the school journey is once more over. And yet it is not over, for the knowledge acquired will enable the scholar to connect many of the features of surface Geography in the eastern and southern districts of England with well-determined causes. What is, perhaps, of still more value to the scholar is the insight he has gained into the new mode of geographical enquiry. This mode of enquiry will enable the learner to investigate in similar fashion other districts which he may visit, or of which he may read. By such journeys as these, Geography becomes much more than a mere task of learning names; it becomes an exercise of the higher powers of imagination and of reasoning.

Concluding remarks and opinions of Her Majesty's Chief Inspector of Training Colleges.

The above is an account of work done for English teachers in English schools. As both aim and plan of the 'journey' depend to a considerable extent upon the material presented by any chosen locality, it may be, that an account of home rambles may prove of greater service than accounts of similar work done abroad. It remains for me to add I have little regard for School rambles which do not demand considerable concentration of effort on the part of those taking part in them. A pleasant outing is not a sufficient aim. The annual school excursion is for pleasure chiefly; the school journey must be a serious though pleasant form of intellectual effort.

In the Departmental Blue Book of 1898-9, Sir H. Evelyn Oakeley reported as follows :—

> 'The study of geography at this College (Westminster) has for twenty years been supplemented by a "School Journey" from Croydon to Godstone, under the guidance of the Master of Method (Mr. Cowham). Before it. maps and plans of the district are drawn, and the general arrangement of the geological formations is studied, *viz.*, the flat clay district of Norwood, the undulating chalk areas beyond Croydon, and the picturesque district of Caterham, due to the presence of sands and gravels in the midst of and upon the chalk. The value of thus connecting the facts of geography with their causes, and of exercising judgment and reason in place of a mere remembrance of names, is obvious. This is the best way to teach geography, and I am glad to learn that some teachers who have been at Westminster have taken groups of their scholars in a similar manner.'

Revision and Summary of advantages of the 'School Journey.'

(1) Accurate first-hand knowledge of a given limited and readily accessible area is gained. This first-hand knowledge—full, accurate, and permanent—gives a possession of high value for purposes of gaining clear notions of districts which cannot be similarly visited.

(2) The power to observe is quickened, and, at the same time, ability to concentrate effort upon a few well-defined objects in the midst of great confusion and variety of material is gradually acquired.

(3) A few truths, strikingly illustrated and capable of wide application, are established in every journey. The accumulation of many isolated facts is avoided.

(4) This mode of enquiry, once fully understood, may be applied to other Districts, and the power to apply knowledge in possession to the acquisition of further knowledge may provide both a means and a stimulus for the exercise of self-effort.

(5) Besides being of direct service in the acquisition of reliable knowledge, the participation in a few 'School Journeys' enables the pupil to use his after-school rambles and excursions rationally, and with pleasure to himself and others.

(6) In some accounts it has been deemed advisable to limit participation in the 'School Journey' to those deserving of prize or distinction. No such limit is advised here. Frequently the dull and indifferent boy in school and in book work proves both active and interested in the out-door effort. This activity aroused by the out-door exercise, re-acts upon the scholar's effort in the school.

(7) Lastly, the social and æsthetic advantages are not overlooked. A love of nature is engendered. Teacher and scholar display mutual sympathy and regard. School work is intellectually benefited and school life is morally elevated.

A SCHOOL JOURNEY TO GREENWICH AND WOOLWICH.

By G. G. LEWIS.

Science Teacher, Bellenden Road, Higher Grade School, Peckham.

Introductory. The following is a brief description of a 'School Journey' by boys in the upper classes of the Bellenden Road Higher Grade School. In this account, it is hoped to show that the school ramble for scholars in large Towns and Cities is a practicable undertaking and is capable of useful development. It is perhaps, just, in this introductory paragraph, for me to say that I am greatly indebted to my former tutor at Westminster for the general plan and conception of the following school excursion.

Ways and Means. In large cities like London, where it is necessary to travel some distance in order to get into the country, it will be found a considerable advantage if several teachers in the school combine and so secure as large a group of scholars as possible. The railway companies take parties of from 40 to 50 at low rates. They also extend these low rates to scholars up to the age of 14—a very important concession where the children of elementary schools are concerned. The majority of journeys hitherto attempted have been to places from 10 to 12 miles distant—the reduced fare for which is usually sixpence each for the return journey. Another sixpence for tea makes the round sum of one shilling, which forms the ordinary cost of the day's outing. The children usually take their luncheon with them. In a school with fairly well-to-do parents, several of these rambles can be taken in the course of the year, and, in this way, Ashstead, Epping Forest, Purley, Crohamhurst and Caterham with the districts in proximity have been visited each year. The trip to Woolwich about to be described is a favourite one because of the varied nature of both surface scenery and underlying rocks.

There is furthermore the river at Greenwich with its passing steamers, Greenwich Park, the Observatory, a free ride over the Woolwich ferry and plenty of fossils. Boys like to come home from their ramble laden with mementoes of their trip, and it is well, therefore, for each boy to provide himself with a school satchel. This enables him conveniently to carry the necessary provisions on the outward journey, and is afterwards useful as a receptacle for any objects of interest he may secure.

Preparations for the School ramble. (a) Home Knowledge.

The teaching of Physical Geography and of Physiography must be based on a foundation of Geological Knowledge. That knowledge need neither be very deep nor wide, but it should be sufficient to enable the pupil to understand the general geological structure of the district surrounding the school and the district over which the journey is to be made. In preparation for this excursion the attention of the scholars is directed to any appearances of the underlying rocks that present themselves. In Peckham there are no quarries, but any excavations a few feet in depth bring up the Woolwich sands and clays with their soft crumbling fossil shells. By frequently examining foundations and sewer sections the scholars become familiar with the rocks which lie immediately beneath their homes and school.

A short time ago, deep excavations were made for the foundations of a new wing to the school. A section was made, the thickness of each stratum was carefully measured and mapped to scale, and specimens of all the materials of the Woolwich beds were bottled and labelled for future use. The scholars naturally ask 'why Woolwich beds'? When told that these beds are found very plainly exposed at Woolwich; that they are there in great thickness; that big quarries are also there, showing the rocks resting on and under them; and that fossils, characteristic of these beds, are to be found in abundance, the scholars express desire to see the district and to examine these beds for themselves.

(b) General knowledge of London Basin.

Interest having been excited, the scholars are further prepared, by being supplied with a general knowledge of the arrangement of the rocks in the London Basin, and one of the objects of the journey is to show the manner in which the rocks of the visited district fit in with the general plan.

It must be made quite clear to the scholars, that, whilst the rocks beneath London take a general basin-like shape (*see Fig.* 3, p. 14), the curve is very shallow and by no means regular and continuous. In order to give the pupils some notion of the series of changes which the rocks of the London Basin have undergone before assuming their present position and appearance, the sketches, Fig. 22, are drawn on the blackboard, and their meaning explained as stated below.

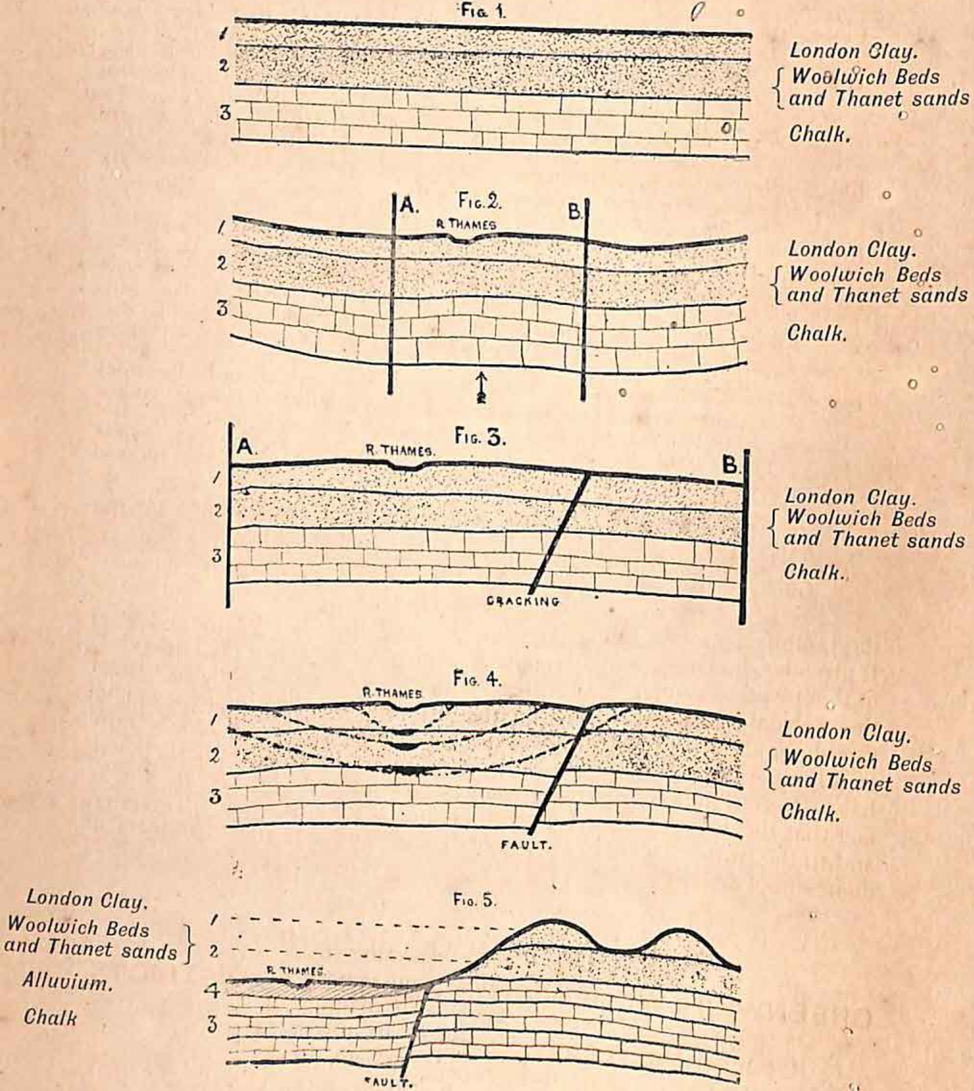

FIG. 22.—A series of figures showing the changes which the rocks in the London Basin have undergone since their deposit (Fig. 1.) to the position they occupy to-day (Fig. 5.) The nature of the change in each case (from Fig. 1. to Fig. 5.) is explained in the adjoining text.

FIG. 1.—Shows the chalk, the Lower London Tertiaries (including our Woolwich beds) and the London Clay in horizontal position as originally laid down.

FIG. 2.—Illustrates the basin-like hollow (very slight) into which the above horizontal strata were thrown subsequent to deposition. The vertical lines, A and B, together with the arrow beneath, are intended to show that in this particular region a smaller force was acting somewhat independently of the general forces. This local force produced a curving of strata in the form of a small and very shallow inverted basin as seen in Fig. 3.

FIG. 3.—Represents an enlargement of the inverted basin-form into which the rocks between A and B have been thrown, together with the tendency of the rocks to yield along the oblique cracking line.

FIG. 4.—Illustrates the crack developing so that the rocks on the right have been lifted bodily to a higher level than the corresponding rocks on the left of the oblique line, thus causing a 'Fault.' As this cracking and faulting have been the cause of the appearance of the chalk in some parts of the school journey where otherwise it would not appear, it is important that the scholars should try to understand the changes illustrated by this diagram. *See also Fig.* 35 *p.* 60.

FIG. 5.—The dotted lines on Fig. 4 are intended to show the action of the River Thames in gradually lowering the land over which it flowed. At the same time it would deposit some of its own mud (alluvium) on its bed and on the marshes on either side, as shown on Fig. 5. This figure represents a section across the lower reaches of the river between Woolwich and Gravesend.

The Graphed Guide.

An important feature of the school ramble is the guide—a paper of directions produced by means of a multiplying apparatus. A copy of this guide is supplied to each scholar. It does not anticipate the ramble too much, but gives information necessary for the journey. It provides drawings (maps, sections, and sketches), leaving, however, in this respect, a great deal for the scholars to find out and sketch for themselves. It may prove of service to reproduce one of these school ramble guides, as the notes and sketches contained therein will be constantly referred to. It will be seen that the ramble, as herein sketched, has a strong Physiographic and Geological leaning. This is due to the fact that the neighbourhood presents material for this form of enquiry, and to the further fact that the scholars are studying these subjects in their school course.

GUIDE TO SCHOOL JOURNEY, GREENWICH, WOOLWICH, & PLUMSTEAD DISTRICTS

1. General Directions.

Meet at Peckham Rye Station at 8.50 a.m.
Report yourself to your monitor.
Take 9.5 a.m. train to Greenwich (L.C D. Rail.).
Change trains at Nunhead.
Walk across Greenwich Park.
Thence across Blackheath to Charlton, Plumstead and Bostal Heath.

Lunch at Charlton; Tea at Bostal Heath.
Return—6.57 p.m. Plumstead to Maze Hill.
7.26 p.m. Greenwich to Peckham.
Take with you (*a*) Lunch.
(*b*) Hammer and Satchel.
(*c*) Small boxes for fragile shells.
(*d*) Note-book and pencil.
(*e*) A copy of this guide.

2. Map of Route (geographical).

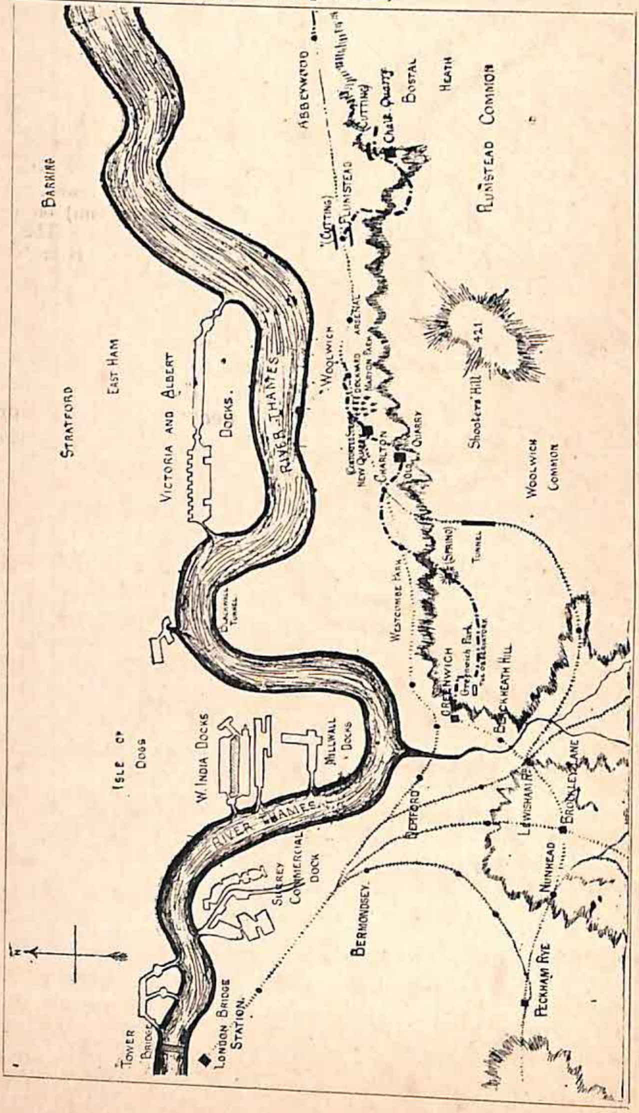

FIG. 23.—Map of School Journey. The 'journey' is marked thus —·—·—

3. Map of Strata (geological).

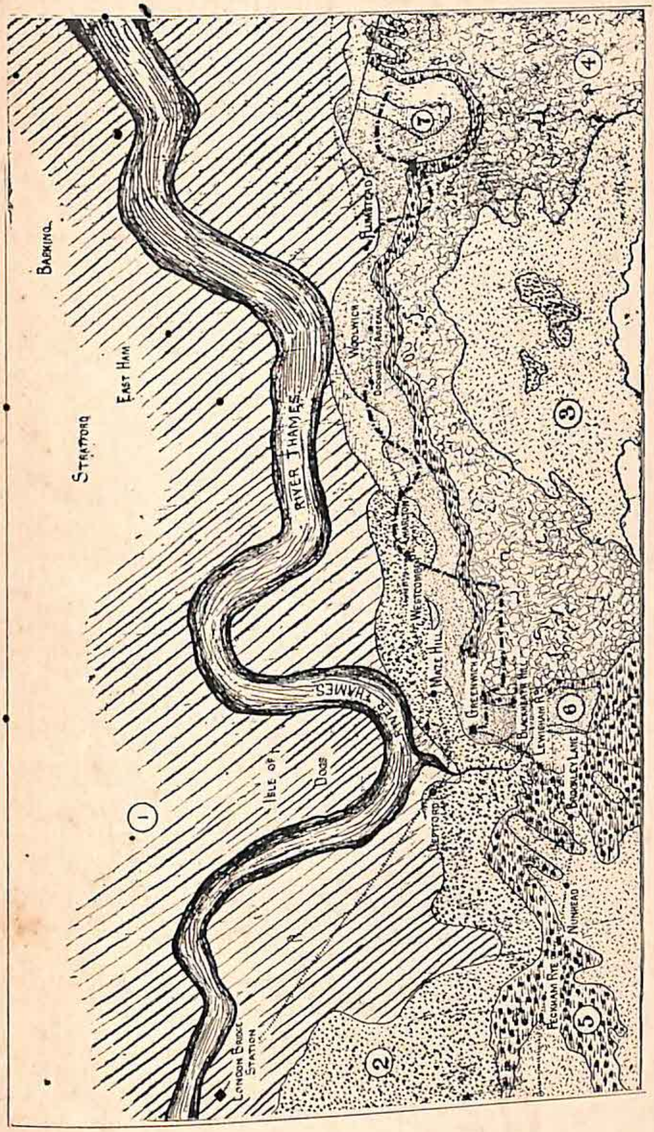

FIG. 24.—Plan of the seven different rock formations seen during the 'journey.' 1 Alluvial. 2 Gravels. 3 London Clay. 4 Blackheath Pebbles. 5 Woolwich Clays. 6 Thanet Sand. 7 Chalk.

4. Sections.

These are printed on the guide, but are not reproduced here. They are distributed throughout the text giving an account of the ramble.

5. Diagrams of Specimens of Rocks and Fossils.

Chalk, Flint, Conglomerate, Thanet Sand, Blackheath Pebbles, Sponges, Sea Urchins, Oyster Shells.

The School Journey begins.

The first stage is by railway. Arriving at Peckham Rye Station at 8.45 a.m. we find 40 to 50 boys already discussing the prospects of a fine day. The first station reached is Nunhead, and here the party changes for the Greenwich train. Whilst waiting the scholars have ample time for noting the great width required for the railway cuttings in the London clay. The slipping tendencies of clays have been already taught. The boys are here requested to take their first note—a sketch showing the angle of slope along the clay embankments.

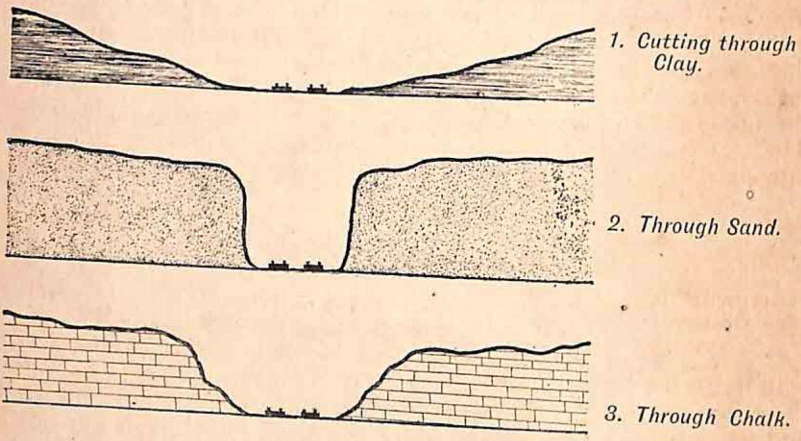

FIG. 25.—Diagram illustrating the different slopes required when railway cuttings are made through (1) Clay, (2) Sand, and (3) Chalk Rocks.

The scholars are instructed to leave space for sketches of cuttings in other rocks to be subsequently visited. The journey to Greenwich present few interesting features. Perhaps the most attractive is the picturesque little valley cut out by the Ravensbourne—a brooklet tributary of the Thames. A railway cutting is afterwards reached, first through sand and then through chalk. This is pointed out, as is also the fact that the London clay, so familiar to them near their homes, is left behind. Passing through a tunnel beneath Blackheath Hill the train arrives at Greenwich.

During the walk through Greenwich town the scholars are not required to march in line as this attracts too much attention, and tends to excite the boys. They walk in two's and three's—a couple of teachers leading the way with some of the scholars, whilst other teachers bring up the rear.

The Social Side.

At this point a slight digression may be permitted. One of the objects of the school journey is to give both teachers and taught a better opportunity of knowing each other. The freedom of the day ramble is far more conducive to this than is the necessary discipline of the class-room. Whilst walking from place to place, the teacher may have interesting and profitable chats, in turn, with two or three of his boys. The writer has found boys unbend more easily on a ramble than they will in a confidential chat after school hours. Apparently they cannot entirely disassociate themselves from the school atmosphere. He has, furthermore, been frequently astonished at the intelligence displayed during the school ramble chat by certain scholars who in school appeared to be somewhat dull. The knowledge thus gained has caused the teacher to alter his method of procedure with these boys, to the mutual advantage and happiness of both himself and his scholars. Considerable tact has, however, to be exercised to prevent the forward boys from monopolising these valuable opportunities. The shy and retiring must be approached and encouraged to enter into conversation.

Greenwich Park and Observatory.

Greenwich park presents much material for conversation. The deer suggest the royal parks at Richmond and Windsor; the Naval School presents association with our island position and the difficulty of defending our wide-spread empire; and the river with its great bend and its shipping serves to impress the scholars with the magnitude of England's commercial interests. Were Greenwich and its associations the subject of our ramble, it would be well to visit the Hospital with its models and its relics of Nelson. As, however, our chief aim is a first-hand acquaintance with some of the facts upon which the truths of Physiography are based, we leave many of these interesting topics with a passing notice, and, at once, climb the hill to the Observatory.

The Observatory is not ordinarily open to visitors, but much can be seen from the outside. The "Great Ball" which falls at 1 p.m. is distinctly visible. The fact that the time (Greenwich mean time), indicated by the falling ball, is kept by all people in the United Kingdom as well as throughout Belgium is pointed out, and excites considerable iterest. The standard measures of length and the twenty-four hours clock also claim attention. Boys who happen to possess a watch proceed to set them to Greenwich time. Aloft, the anemometer can be seen working busily in the breeze, whilst within the great domes (giving the Observatory the appearance of an Eastern Mosque) are the astronomical and other important telescopes. Greenwich must not be left without seizing the opportunity of imparting a little knowledge of longitude. But rarely can a scholar be certain of standing with one foot in east and one foot in west longitude.

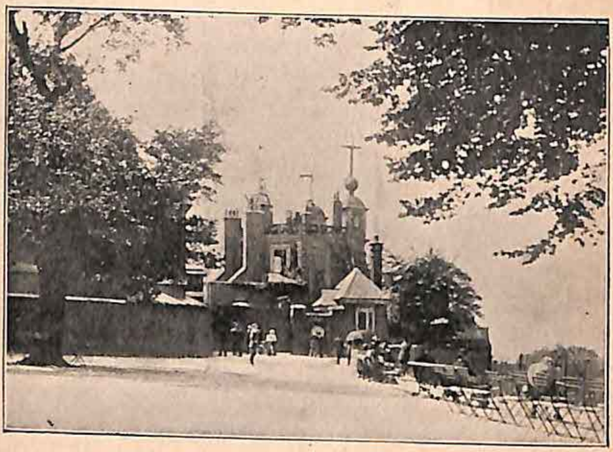

FIG. 26.—Greenwich Observatory. Scholars in front are examining the Twenty-four Hour Clock. Those on the left are looking at the Standard Measures.

Blackheath. A short straight path from the Observatory leads to the 'table-land' of Blackheath. Its elevated and even surface is at once recognised. The scholars are asked to describe the surface aspects of the 'Heath.' They see it to be an open and elevated common of considerable size, dotted over with furze bushes. An examination of the surface rocks shows that the soil is intermixed with beautifully smooth and rounded black pebbles. The scholars have already had lessons on the formation of gravel and pebbles and are able, in answer to questions, to tell the teacher that these rounded pebbles must have had a long time of hard wear and tear—all the corners having been completely rubbed off. (For illustration see Fig. 42, p. 71).

Conversation on the Blackheath Pebbles.

The following conversation is held between pupils and teacher whilst they survey the pebble covered heath.

'Where have you seen pebbles something like these?'

'At the sea-side,' say the boys, 'but not so round and smooth.'

'What is each pebble on the Heath made of?'

As no reply is immediately forthcoming, a pebble is broken open. 'Flint,' is now the ready reply.

'Why does flint withstand so much battering?'

'Because it is very hard.'

'The flints must have come from somewhere. Would they come from rocks above or below the Blackheath Bed?'

'Above,' answers a boy, quickly.

'But why do you say "above"?'

'Because they would then be washed down,' is the reply.

The boys are then told that the only rocks in the neighbourhood in which such flints are found is the Chalk. Now they have already seen that the Chalk is found below the beds on which they stand. Not far away, however, the same chalk strata rise considerably above the level of Blackheath. From these elevated chalk strata the flints must have been washed by the action of waves and breakers on a sea-shore. After much rolling they rested on the Woolwich clay beneath, and thus became the Blackheath beds of gravel and pebbles.

Again the question is asked, and the boy who said 'above,' correcting his previous reply, now says 'below.'

The scholars are asked to tell, as completely as they can, the history of one of these Blackheath Pebbles. The reply, in brief, should take the following form, viz:—

'The flint matter was originally deposited in the Chalk beds. These beds were then elevated. The sea, with its tides, waves, and breakers, washed away the soft chalk and rolled the pebbles into a round shape, and afterwards deposited them at the level where they are now found.'

Whilst crossing the 'Heath,' conversation turns upon matters of general interest. One boy recalls the fact that Wat Tyler and his men of Kent assembled on Blackheath prior to marching into London to demand the redress of their grievances. The golf-players are next observed. London boys appear, for the most part, to know little or nothing about the game. One little fellow, however, who, the day before had no sums worked correctly, and, in consequence, had fallen somewhat in his teacher's estimation, now ventured to speak. He said 'he had read in the newspapers that the Leader of the House of Commons played golf in Scotland.' This boy was commended for taking interest in current events.

A Spring.

The path continues along the edge of the Blackheath plateau, as shown on the map (Fig. 24), and by a short and somewhat steep descent leads to Westcombe Park Station. A few boys who have wandered out of the beaten path suddenly stop amidst expressions of surprise. They find themselves caught in a quagmire. What does this mean? It is found that the boys have left the dry Blackheath pebble beds, and have stumbled upon the clay of the Woolwich beds. This proves to be a most instructive spot, as it provides the little company with a very good example of a spring.

The guide sheets are taken out and the scholars refer to the section across the escarpment (Fig. 27). They are asked to point out the exact position on the section favourable for a spring, and the following conversation ensues.

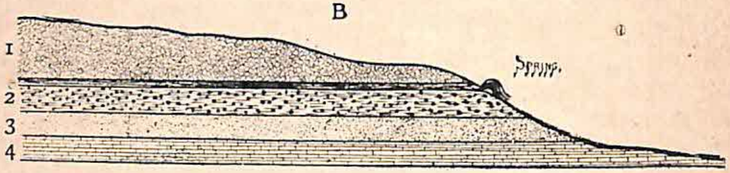

FIG 27.—Showing the arrangement of rocks favourable for the formation of a 'Spring.' The rocks represented are as follows:—

1. Blackheath pebble and gravel beds.
2. Woolwich sands and clay.
3. Thanet Sand.
4. Chalk.

'What kind of rocks form the plateau we have just left?' 'Pebbles.'

'Would this rock allow water to pass through?' 'Yes.'

'Where would the water go that fell on the Heath?'

'It would pass down until it reached a layer of rock that would stop it.'

'Look at the section and name the layer which would stop the water.' 'The Woolwich clay.'

'What would become of the water when it reached the clay?' 'Run along the clay until it could escape.'

'Look at the ground near you and point, if you can, to any places where the water escapes.'

The scholars are then told that round the elevated plateau of Blackheath there are very many springs. They now recognise that these springs indicate the junction of the Woolwich with the Blackheath beds.

An application of this knowledge to another London District is now attempted. A sketch is made showing the arrangement of sand on the top of the London Clay on Hampstead Heath. The scholars are asked to point out positions on the sketch favourable for the existence of a spring. They are asked to visit Hampstead Heath, when opportunity serves, and to find the once famous 'Well Walk.' with its chalybeate spring. Other springs in and about London are afterwards named, as for example, Camberwell, Stockwell, Clerkenwell, &c.

Houses and Soils. Streets of new houses are being built near. The boys are asked their opinion upon the sites in the neighbourhood.

'Would you like to live in a house built on the clay?' 'No.'

'Why not?' 'Likely to be damp' is the reply.

A few yards higher are the pebbles and gravel. Yes, they would rather live on these.

'Why? Do you think there might be danger from building on the thin bed of gravel resting on clay?'

'Might slip' replies a boy.

'What would be the best place for a house do you think?'

'Higher, and near the top of the pebbles,' is the thoughtful answer.

'Lower down you see the sand comes to the surface, would you like a house built on the sands?'

'Yes,' is the reply, 'because it would be dry.'

'But the garden would want much watering!' adds the lazy boy.

In this locality within a very short distance are no less than four different surface rocks (see Fig. 27). On the top of the hill are the Blackheath pebbles; lower down are the Woolwich beds; whilst still lower is the fine pure Thanet sand resting on the Chalk. The boys are asked to make a diagram showing the arrangement of these rocks.

Marshes.

The path now passes under Westcombe Park Station into the main Woolwich Road, towards Charlton. On the left are acres of low lying level alluvial land. These marshes extend a mile northward to the banks of the Thames. At present they are cultivated and supply large quantities of garden produce. Were it not for the Thames embankments the water at high tide would submerge the entire area. The scholars are asked to suggest the source of this dark coloured garden land. They answer readily 'that the Thames must have supplied it in times past.' They are told that many years ago these lands were un-enclosed and were constantly being flooded by the Thames during high tide. At low tide, sluices into the Thames are opened and the surplus water escapes. By means of these banks and sluices the land has been brought under cultivation.

'Like Holland' suggests a thoughtful scholar.

'The Fens of Lincolnshire' says another.

Charlton Old Quarry.

We leave the main road at Charlton, pass over the railway once more, and, turning down a street of newly built houses, suddenly arrive in full view of the 'Old Quarry' at Charlton.

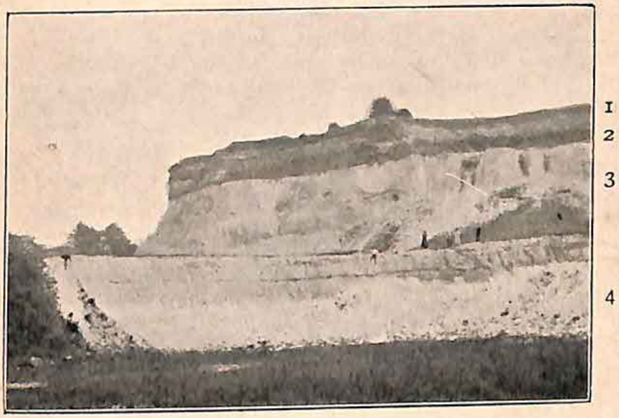

FIG. 28.—Old Quarry, Charlton, exposing in vertical section the following strata, viz. :—

1 Blackheath Pebbles.
2 Woolwich Beds.
3 Thanet sands.
4 Chalk with lines of flints.

This is probably one of the finest sections of nearly horizontal strata in the country. An enormous mass of material has been removed as ballast for ships, but the quarry is not worked at present. After the first impressions of surprise and admiration are over, the scholars are asked to identify by means of the section Fig. 29 each of the strata now in full view. The Thanet sand and the chalk are sufficiently plain. There is, however, some little doubt as to which are the Blackheath beds, and not a little surprise is expressed at their thinness. The scholars soon recognise that only a very small portion of these beds remain, whilst the rest have been washed away.

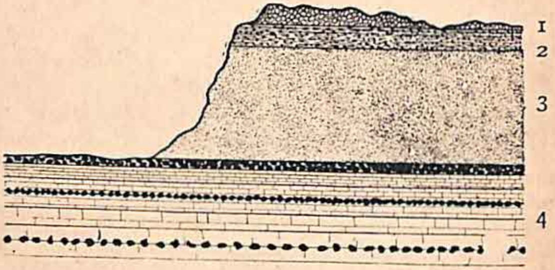

FIG. 29.—Diagram, vertical section of rocks shown in Photo, Fig. 28.

Formation of sandstone.

A boy wishes to know why the sand stands so nearly upright. He evidently expected that the sand would shape itself into a slope. To satisfy the boy's enquiry, we walk across the space which has been cleared from the quarry, clamber up the somewhat steep slope to the top of the chalk and walk along the almost vertical wall of sand. The boys take some of the sand in their hands. They find it to be firm and to require considerable pressure to make it crumble

'Why is this?' 'Why does it not fall apart like the silver sand bought in London?'

No one answers. The boys need helping, not telling.

'There must be something in this sand not found in the loose sand you buy?' 'What can it be?' asks the teacher.

'Something to hold it together' is rather thoughtlessly ventured in reply.

'It is rather damp,' says another boy, feeling the sand carefully.

'Yes' says the teacher. But, taking up a piece that is both dry and hard, he says, 'you see this also holds together.'

Another boy suggests that its hardness may be due to the presence of salt.

'Taste it' says the teacher.

'No, it is not salt.'

'There is a substance holding it together, and I will tell you this much—it is a solid.'

Still no reply.

'What colour will it be?' asks the teacher.

'White' answers one looking at the bright colour of the sand.

'I think I know' breaks in a boy. 'It must be lime.'

'But where can the lime come from?' asks the teacher. 'You see the chalk is beneath the sand.'

'Is there any lime in the Woolwich beds above?'

'Only in the shells embedded in them' is the answer.

'I may now tell you' says the teacher, 'that the lime of those shells is dissolved in the water as it slowly trickles through the Woolwich beds. This lime is then deposited around the sand grains and makes them hold together.'

'Can we make sure that this white coating is lime?' asks the teacher.

'Yes, by testing with an acid' replies a scholar with a slight knowledge of chemistry.

A thoughtful boy suggest that the stone before them is a sandstone in process of formation.

Specimens are taken for treatment in the school and for examination under the microscope.

Collection of Specimens.

As the scholars approach the debris at the foot of the cliff of rock, they are delighted to find numerous fossil shells. They are somewhat disappointed, however, to find they are so much decomposed and very fragile. Specimens of conglomerate and iron concretions are now collected, but it is found that the boys prefer, for some reason or other, to collect fossils.

The line of argument used above to explain the formation of compact sandstone is followed in explanation of the formation of these conglomerates. In this case, however, iron and not lime is the cementing material. Specimen are again taken for mounting and for analysis.

Flints—a difficult question.

A boy now runs up to the teacher holding in his hand a large flint covered with a greenish looking substance. 'Yes,' says the master, 'I have been expecting that someone might probably find one of these. If you look round you will find many more. They are lodged in great quantities on the top of the chalk. I may tell you that I cannot explain to you the origin of that green coating. Some day or other the origin may be found out but at present it is not known.

Several flints are now broken open, and one, containing the cast of a siliceous sponge, is examined. The boys already know that diatoms and radiolaria are composed of silica obtained from seawater. They are told that some of this silica is either deposited round these sponges (like sugar candy round a piece of string), or, it is deposited in the hollow of the chalk. In this way, the presence of flints in the midst of chalk is explained.

Why flints are found in a thick layer on the top of the chalk is an enquiry that presents some difficulty. The following conversation takes place on the sujbect.

'When rain water falls on the Thanet sands where must it go?'
'Into the chalk' is the reply.
'What effect has rain-water on rocks composed of lime?'
'Some of the lime is dissolved.'
'Name a rock mixed with the chalk that rain-water could not dissolve?'
'Flint' is the ready response.
'If the chalk be dissolved and the flints not dissolved, what would be left on the top of the chalk?'
'A layer of flints.'

Thus the presence of a considerable layer of flints without chalk resting on the top of the chalk is explained.

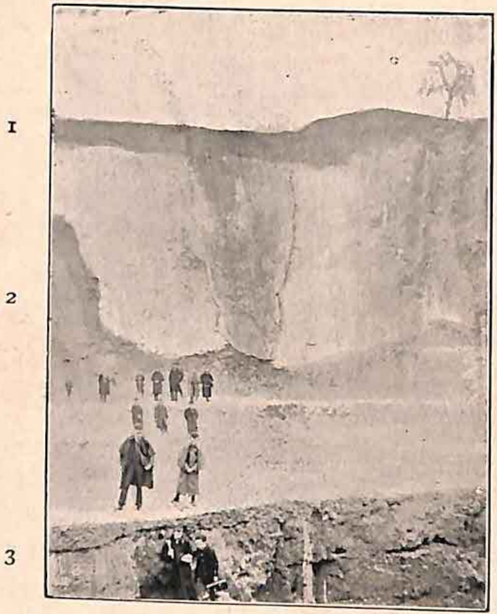

FIG. 30.—New Quarry at Charlton exhibiting in vertical section the following strata:—
1. Woolwich Beds.
2. Thanet Sand.
3. Chalk with layers of flints

A useful Quarry.

After lunch a visit is paid to a neighbouring quarry which is being worked. Permission to enter is readily granted from the foreman in charge. Quite a variety of material is in process of being carted away, and no less than six different destinations are being found for it.

1. The Chalk is burnt into quick-lime.
2. Some of it is used as a flux in the adjoining Arsenal.
3. The Flints are used for road metal.
4. The Sand is sent to a factory and used in making glass and china.
5. The Clay is used for brickmaking.
6. Other material of no industrial value is carted away for ship ballast.

Each of the above facts becomes surrounded with a host of enquiries, and the conversation thus broadens out into a number of interesting little object lessons. Search for fossils in the chalk is now made in earnest. Several are found and identified, and a few 'Shepherd's Crowns' (sea urchins) are obtained from the quarrymen.

Maryon Park.

We now turn round the side of the quarry, and after a steep climb reach the higher platform on which gravel is being quarried. A fine view over Woolwich repays the effort. On the right are the Royal Artillery Barracks. Immediately in front is Maryon Park, transformed by the London County Council from an old disused quarry.

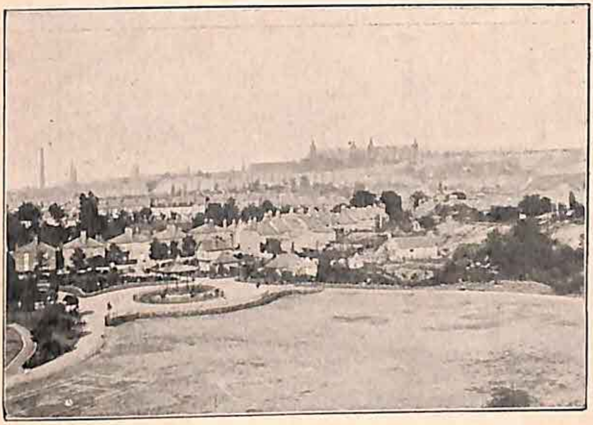

FIG. 31.—View over Maryon Park, with Woolwich in the distance.

The Arsenal is slightly to the left, marked by its many shafts, whilst in the distance, still further to the left, the silver streak of the Thames is clearly seen.

Immediately under the brow of the hill the Woolwich beds are exposed in a line running the entire length of the park. Considerable scrambling is required in order to reach them. The boys enjoy the effort, and are afterwards amply rewarded by a rich find of Cyrenas and oyster shells. These are carefully packed in wool-lined cardboard boxes. A conversation on the origin of these beds ensues. By reference to the conditions which now obtain at Whitstable (a place visited last year), the pupils are led to the conclusion that these Woolwich beds were deposited originally in the estuary of a large river. Before leaving this interesting set of rocks the boys are taken to see a remarkable variation from the almost uniform horizontal bedding of these rocks.

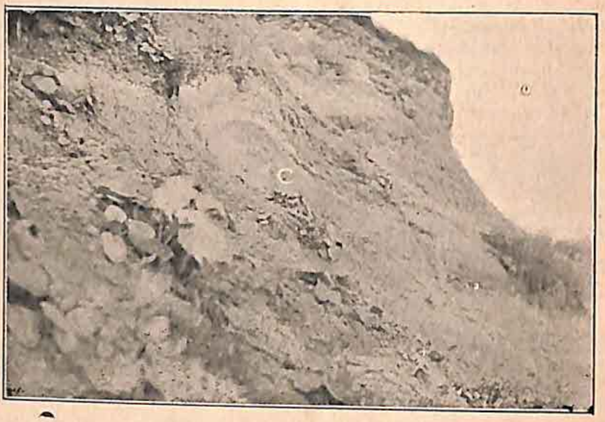

FIG. 32.—Photo of section of Woolwich beds running along the entire length of Maryon Park. The Section exhibits an example of contorted strata. See the curve in the strata immediately above the letter 'C.'

The scholars are told to search for this contortion in the bedding. The writer knows no better example of disturbed strata in the south of London. It is well marked, and serves admirably to exemplify one of the results of side pressure.

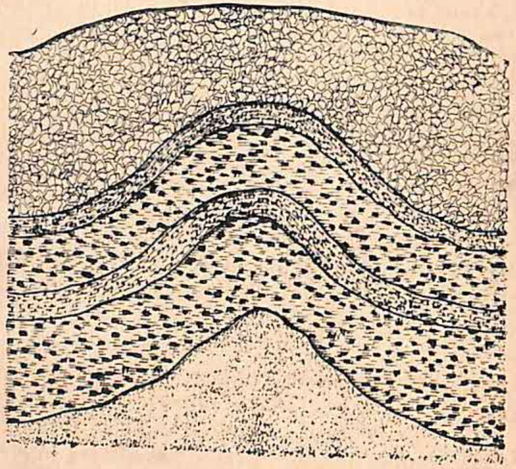

FIG 33.—Diagram sketch of the curved strata in the Woolwich beds of Maryon Park marked 'C' on the photo, Fig. 32.

The accompanying sketch of curved strata is made for insertion in the written account of the journey, which every scholar is expected to make.

From these fossiliferous beds the scholars reluctantly move to Woolwich Dockyard Station to take train to Plumstead. Reference to the Geological Map shows the station to be situated on Thanet sand. The S.E. Railway has made a deep cutting through this sand, thus revealing a very clearly marked section. The boys draw a cross-section diagram of this cutting under that of the London clay for purposes of comparison, making the permanent way the same width in both cases (see Fig. 25). They see, at once, how important it is for railway surveyors and contractors to know the angle at which the clay and sand respectively rest.

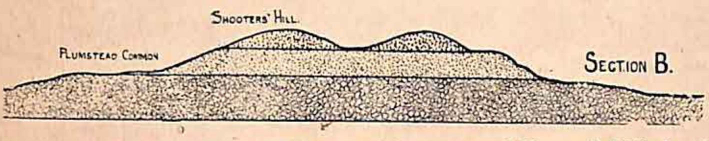

Fig. 34.—Vertical section across Plumstead Common and Shooter's Hill, showing Blackheath pebbles of Plumstead Common as the lowest stratum. Above is the London clay of Shooter's Hill with its cap of gravel.

Plumstead Common.

A short walk brings the class to Plumstead Common—like Blackheath, a tableland of pebbles. Shooter's Hill comes at once into view, and demands attention. The boys are told that it is composed mainly of London clay with a cap of gravel (see section, Fig. 34). Here, a difficulty presents itself. If any fact has been driven home more than another, it is the fact of clay weathering into a flat area. But, here is an apparent contradiction. The following conversation clears up the difficulty:—

'Why does this particular piece of London clay remain standing so high?' In reply, the class is directed to the Geological Map.

'What is on the top of the clay on Shooter's Hill?'—'Gravel' is the reply.

'What does gravel do for the plateau at Blackheath?'—'It preserves it from waste by rain and running water' is the response.

'Tell me now the reason why the London clay of Shooter's Hill does not weather into a flat area?'—'The gravel on the top protects the clay' is the ready answer.

Attention is now directed to the well-wooded slope of Shooter's Hill. These are contrasted with the bare condition of Bostal Heath. The fact that clay is much more fertile than the pebble-covered heath is at once evident.

Changes of Scenery due to Changes in Rocks.

The effect of a variety of rock formation on scenery and vegetation becomes clear as instances like the above are multiplied. This truth should not be told, it should be allowed gradually to establish itself. The teacher may accelerate its growth by bringing other instances of change, from hill structure to plateau and plain, where variety of rocks are found. He may still further aid, by referring to monotony of outline, wherever the same rock subsoil prevails over an extensive area. One important result of these journeys should be to establish the following truth, viz., that most of the charming variety in the scenery around London is due to the changes in the surface rocks in adjacent areas.

The making of a Valley.

Walking over Plumstead Common the boys come to a small but very pretty valley, on the other side of which the trees of Bostal Woods come into view. The little stream which has hollowed out the valley has cut its way down to the chalk, see Fig. 35. This chalk is being quarried at the foot of the valley. The scholars' attention is more especially directed to the surface details. From the position they occupy the entire valley can be seen, as can also the little side valleys through which tiny tributaries flow into the main stream. After a ramble at will along the sides of this valley the scholars assemble for tea, which is provided on Bostal Heath.

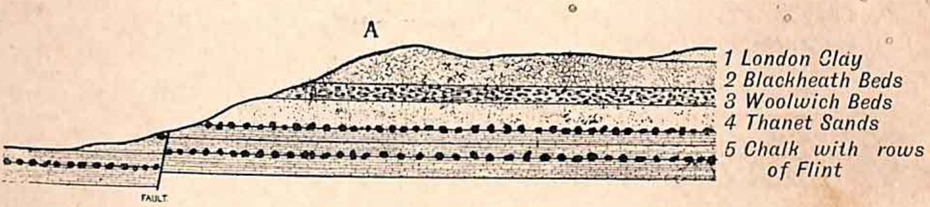

FIG. 35.—The wearing away of upper beds into a valley, exposing the chalk on the left and right of the line of 'Fault.'

Tea.

The scholars descend into the valley; they cross the chalk exposure (an interesting example of an 'inlier'), and they climb the opposite side on to the Heath. After grace has been sung, the boys sit down to a well-deserved meal. The teacher, whilst unobtrusively superintending, notes fresh traits of character in his boys. The desire to satisfy a keenly sharpened appetite serves to awaken latent energies, some of which need to be restrained. The boys are encouraged to act towards one another with consideration and politeness.

How the commons round London have been made and preserved.

After an hour's play amongst the bushes of the 'Heath,' the scholars assemble again for a short and final conversation. They stand on one of the spurs of the Heath, commanding a fine view across the marshes to the great city, 14 miles distant.

After a few moments quiet survey, the teacher asks the class to name the three 'Commons' they have visited.

'Blackheath, Plumstead Common, and Bostal Heath,' is the reply.

'What has formed the rock material in each case?'

'Pebbles or Gravel.'

'Can any one suggest why these commons have not been occupied and cultivated like the surrounding land?'

'Because they would not be worth occupying for cultivation. Nothing of value would grow upon them,' is replied.

There are very many other commons in the neighbourhood of London which have not been enclosed because, being covered with gravel and pebbles they were thought to be of no value. Wandsworth, Clapham, Wimbledon, Hayes, and other commons are examples.

Attention is now directed to the sections across Shooter's Hill, Fig. 34, and Bostal Heath, Fig. 36. In each case an outlier of London Clay is surrounded by a pebble tableland, and in each case the London Clay area has been enclosed and cultivated, whilst the pebble area remains open common.

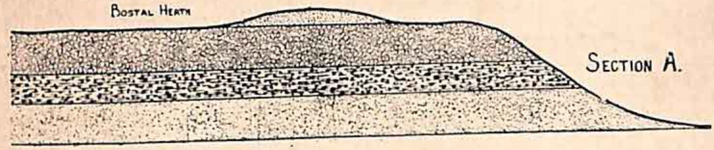

FIG. 36.—Diagram, vertical section of rocks at Bostal Heath.

Home. The boys now march homeward. The walk to the nearest station tends to become rather tiring. It is found, however, that the boys cover the ground with less of apparent effort when keeping step than when they saunter along in loose order. Plumstead Station is reached at last, ten minutes before the train is due. The journey home is now beguiled with song and story. Boys and teachers separate at Peckham Rye the best of friends, bidding each other good night, and wishing the next ramble may be as happy as the one just completed.

It will probably be remarked that this ramble provides much work and but little play. That is so. The ground, however, is so rich in material that it is very difficult to omit any. The boys, it may be said, anticipate this ramble very much, and from this we judge the work is not too severe.

It is needless to add that the school museum is the richer for these excursions. The boys regard it an honour to have one of their specimens accepted for exhibition.

Photography is made to aid the rambles. Lantern slides are prepared from the photographs taken *en route*. These are afterwards used to illustrate lessons given during winter evenings.

AN ACCOUNT OF A SCHOOL JOURNEY ALONG A RIVER BANK IN LANCASHIRE.

CONDUCTED BY THOS. CRAWSHAW.

Wesley School, Padiham.

Introductory.

As a means of stimulating a love of nature, and, as a valuable aid to the study of Physical Geography the 'School Journey' has become widely appreciated. The schools of Germany and Switzerland, with their extended Geographical tours, are doubtless in advance of many of the educational institutions of our own country. In England, however, a much needed reform in educational procedure has began to manifest itself. Considerable latitude in the choice of school subjects and in the method of teaching them is now permitted, and it may be reasonably assumed that the old method of making the scholar a mere receptacle of geographical facts will soon belong to the past.

In the following account it is proposed to show how the 'School Journey' may be made the means of exercising the observing and reasoning powers of children in the middle and lower classes of our schools. As river features form an important element in the geographical course for junior pupils the outline of a journey over a portion of a Lancashire stream may prove of service. The river selected is the Calder, a tributary of the Ribble, and the journey extends from Padiham to Whalley.

Connection between the outdoor ramble and Class-room Teaching.

It should be noted that these 'rambles' are not to take the place of the teaching of the class-room. They are primarily intended to illustrate and enlarge that teaching, and, at the same time, to render the work of the class-room much more real and interesting. It is a common experience to hear children glibly recite the definition of a geographical term without knowing its full and true meaning. The 'school ramble' should aim at supplying first-hand and direct knowledge of a variety of geographical facts sufficient to enable the scholar to acquire the general notions which the geographical terms imply.

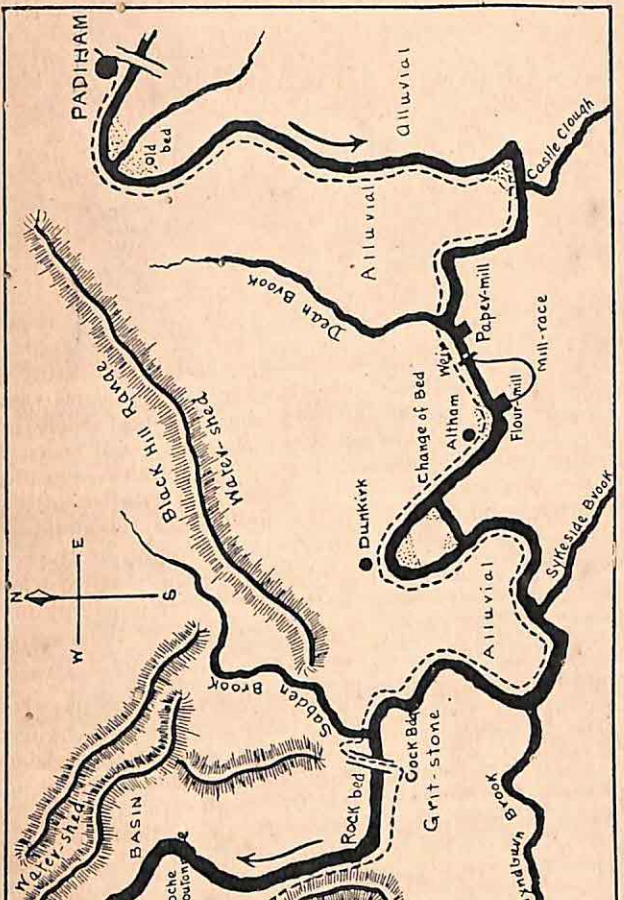

FIG. 37.—Map of 'School Journey.' The route is indicated by the dotted line.

There is this further advantage from the 'ramble.' It provides the members of the class with a fund of knowledge *common to all.* The class teacher knows the great advantage of this. When the illustrative examples he uses are familiar they prove most effective for the purpose of establishing general knowledge. Over and beyond the aid which the first-hand particular knowledge affords for arriving at the accurate meaning of geographical terms there is the enhanced power which a vivid recall of familiar scenes supplies for realizing the geographical knowledge beyond the region of experience.

Material is abundant in most school districts. It only remains therefore for us to state the steps taken in a given locality to make the most of the material therein presented.

Preparation for the Journey.

Though the subject matter must necessarily vary in different parts of the country the method of preparation will, in most cases, be the same. The following preparatory steps should be taken :—

1. A portion of country should be selected which contains well marked examples of the geographical features to be taught.

2. The teacher must make a careful study of the district. He should not only become thoroughly conversant with the district by reading and direct personal enquiry, but, he should thoroughly rehearse the journey in all its most important details before attempting to conduct a class over it.

3. The route chosen should not be long. It should be one easily walked over by an average scholar in an afternoon, say of about three hours.

4. Each scholar should be provided with a sketch map of the selected route, drawn to a recognised scale. Ordnance survey maps of every district can now be obtained. They are the best for the purpose as they contain the levels of roads at regular intervals as well as the heights of all important summits. In some cases, a request to the district surveyor, secures ready access to very valuable details of a particular district.

All matter foreign to the subject under review should be eliminated from the scholars' maps. There should be little or no difficulty in obtaining sufficient copies of this map. By one or other of the many well-known multiplying processes a copy for each scholar may be obtained. Perhaps the most satisfactory map is the one the scholar prepares for himself from a careful study of the map drawn by the teacher.

5. A pocket compass will prove of great use. It will enable the scholars to locate the relative positions of the most important geographical features observed during the journey. The scholars should be encouraged to use this compass, and, by its aid, should be expected to mark every stopping place on the map. A line joining each stopping place would represent the route taken.

6. In order to test the rate of water movement, and for the purpose of taking samples of water, it is necessary to provide a few bottles with tightly fitting corks.

Photographs might be taken of the chief points of interest. The writer produces lantern slides from these photographs. These slides are afterwards used in school lessons, either for exercise in revision, or for additional lessons in geography.

The commencement of the Journey.

If the journey be the first of its kind the scholars may, at starting, tend to become rather excited, and be somewhat inclined to roam at large. Their curiosity will be expended on the survey of a wide array of natural objects. Living things such as birds, butterflies, fish, etc., and brightly coloured objects such as flowers will receive undue attention. The tact and resource of the teacher must, at the outset, manifest itself. He must encourage the feeling of curiosity and of anticipation with which his pupils begin the journey, at the same time he must skilfully direct their observation and interest so that their buoyant energy be spent in the acquisition of knowledge. It must not be squandered in aimless though enjoyable effort. The following paragraphs set out in detail the most important items of geographical knowledge which the 'school journey' along the banks of a river provides.

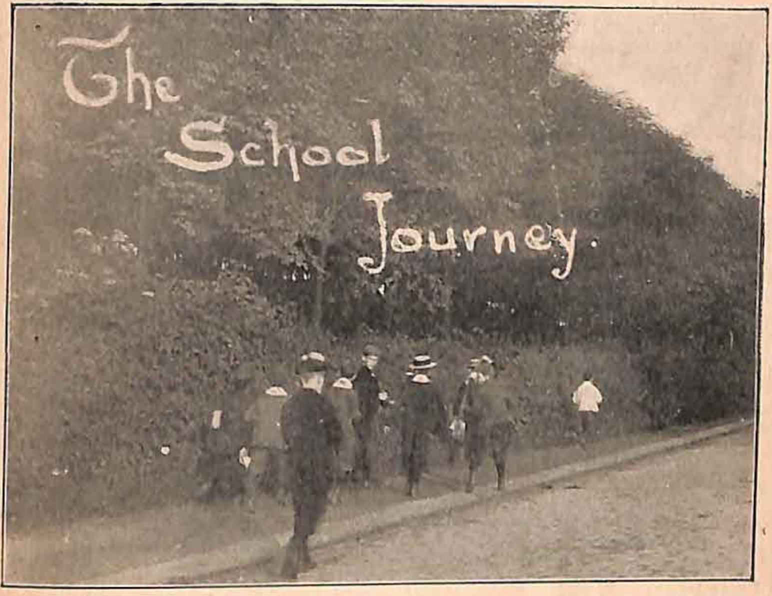
The School Journey.

FIG. 38. Photo of scholars 'en route.'

The flowing water, currents, ripples, eddies, &c.

After arriving at the stream, the attention of the scholars is directed to the movement of the water. They are asked to point out the direction of this movement. A reference to the position of the sun enables them to state more exactly this direction; a further reference to the pocket compass helps the class to confirm this decision. Attention is now directed to less striking details of the water movement. A piece of rock in mid-stream causes an uneven surface in front and by its side. The scholars are asked to name these little irregularities. They are further asked to name any other way in which the surface of the river becomes 'rippled.' The tiny 'eddies,' or whirlpools formed by the rush of flowing water beyond the obstruction are then observed. Two kinds of movement are now contrasted, viz., that of the river as a whole, thus giving the idea of *river current*, and that of small portions of the river surface giving the ideas of *ripple* and *eddy*. The scholars are now asked to use their ears. They detect the 'murmur' of the water, and the term 'babbling of the stream' is introduced.

Why is this murmur of the water compared to babbling?

They are reminded of the little ones at home and are asked to say who is said to babble there. The idea of noise without speech is thus conveyed. The scholars are now asked to listen more carefully, and after a short interval they are able to point to the spot where the chatter or babble is most distinct. In this way they are led:—

1. To connect the noise with the ripples and eddies already noticed, and,

2. To discover the cause of the babbling, viz., the rushing of the water over shallows and amongst the rocks and stones.

Before leaving this first stage of the journey an attempt must be made to explain the cause of the river movement. A reference to the sloping of a house-roof, or to that of a road from the crown to the sides, and to the effect upon rain falling on either of these slopes, will suffice to associate flowing water with a sloping surface. From these simple experiments the pupils are led to infer that the ground must slope in the direction of the flow of the water. This slope, however, cannot be seen. Its effects the scholars see; the cause of water movement they infer.

So far our first contact with the river has yielded exercises in observing very simple phenomena. The obvious association between some of these observed facts has led to the discovery of a deeper connection between them. For example, that ripples, eddies, and the babbling of the stream are connected with the rocks and stones of the river bed. An easy effort of reasoning has also been attempted, and, throughout, the opportunity has been afforded of associating several terms with their full and accurate meaning.

The current flows fastest towards the middle of the Stream.

A straight portion of the river is now selected, and an attempt is made to obtain by experiment the different rates of water movement across the stream. Two boys throw simultaneously well-corked bottles into the water; one bottle is thrown towards the middle, the other near the side. Each cork carries a strip of white paper to make the object more distinct. A few moments careful observation are sufficient to show that the bottle in mid-stream quickly leaves the other behind. The following question at once arises, *viz.*, 'Why does the water flow so much more quickly in the middle of the stream?'

No answer being forthcoming, the teacher (instead of immediately telling it) performs a simple experiment, whilst the children gather round and watch.

Taking a sheet of paper he folds it into the shape of a cone. After filling it with clean sand he opens slightly the apex end of the cone. The sand lowers quickly at the centre and very slowly at the sides. 'What holds the sand back at the sides?' The idea of friction hindering the side movement is in this way made evident.

The attention is again directed to the river and the former question is repeated. Some of the more thoughtful children are ready with the correct reply. The others are then asked where the water is deepest, and where it is very shallow. These questions are followed by others, such as—'Where will friction hinder the flow of the river most, and where least?'

In this way, by help more or less full, the different members of the class are enabled to acquire the correct and full knowledge for themselves. This notion of most rapid flow in mid-stream will be modified when the movement of water along the first bend of the river is reached.

> A word of caution to bathers in flowing streams is given at this stage. The boy who may be able to stand easily against the current in shallow water is warned not to trust himself into the deeper current.

Banks, how made; right and left banks.

For purposes of contrast the class is reminded of the banks of the stream where it passes through the town in which they live. There the banks are made *for* the river. Here, in the open country, the river is not kept within its bed by stone and cement walls.

What makes the banks they now see?

In order to assist the scholars to reply, they are asked to recall some of the effects of a very heavy rain shower upon the roads. The water runs down to the sides of the road and makes little channels in its course. With more rain these runnels become deeper and deeper. In this way the runnel is seen to make its own tiny banks. The attention of the class is now directed to the river with its high banks, and the following questions are asked:—

'How have the banks been made?'

'Why are they so high?'

'What will make them higher?'

The scholars have been taught the right and left banks of a river, respectively, in their school lessons. This knowledge may be revised and impressed by the following little exercise. Two boys are supplied with a card each—one marked R (for right bank), the other L (for left bank). They are then asked to choose the side of the river answering to the initial letter in their hands. The remaining scholars are asked to approve or otherwise of the choice made by their schoolfellows.

The winding river bed.

Shortly after leaving the starting point of the journey the scholars mount to the top of a high bank, from whence the winding course of the stream is visible (Fig. 39). The view is both extensive and picturesque. For a time the scholars are permitted to quietly observe and enjoy the scene. After pointing out the several bends of the river, they are asked if they can tell why the course thus winds along.

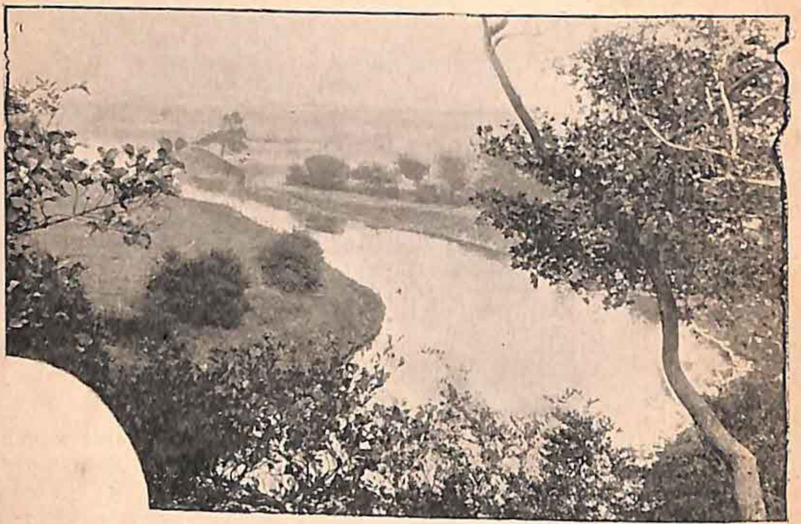

FIG. 39.—The winding course of the river.

The scholars are not expected to answer this difficult question. It serves, however, to direct their thought to the subject, and thus to prepare the way for the following simple form of explanation.

A large bottle is filled with water. This water is poured gently down an even slope. The scholars are told to mark the direction taken by the running water. Another slope is now selected having many irregularities at various points of the slope. Water is again poured along the slope, and the scholars are set to observe the effects of these obstacles upon the flow of the water. The obstacles, in turn, divert the water, and, as a result, the course becomes winding. The following questions are asked, viz. :—

'What difference in direction do you see in the two water courses?'
'Why is the first course a straight one?'
'Why is the second course crooked or winding?'
'Now look at the river bed and tell, if you can, why its course is not straight?'

The river changes its bed by wearing away the hollow or concave bank.

The river, at this point, takes a sweep round a curve of rather small radius, being prevented from running straight along by a slight elevation on the concave bank. The scholars have little difficulty in seeing that the rush of water is towards the concave side, and that, as a result, this bank is being much undermined and hence rapidly worn away. The stones and other debris at the foot of this bank fall from above and accumulate

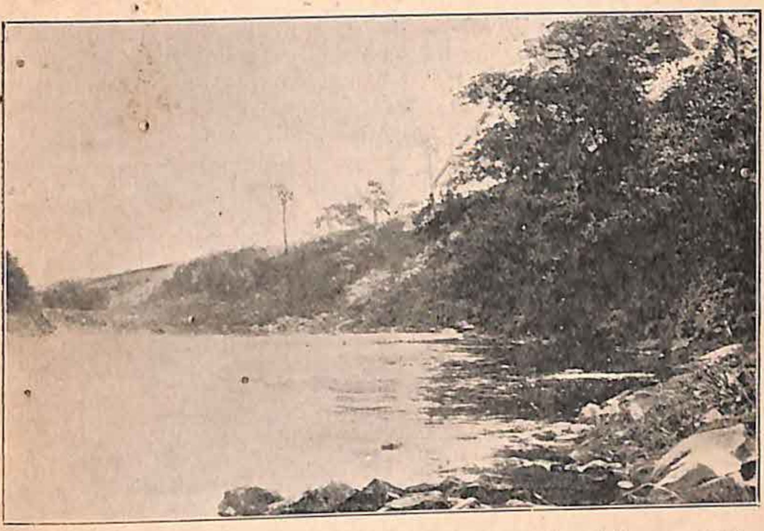

FIG. 40.—Debris accumulating at the base of the right hand bank (concave side).

as shown in the above photograph (Fig. 40). Another result, and one which presents some difficulty, may be noticed at this point. By this constant undermining of the concave bank and by the consequent falling in of the rocky matter from above, the concave bank tends to be pushed further and further back, and, as a result, the river bed, year by year, becomes more and more winding. This result is illustrated by the following diagram.

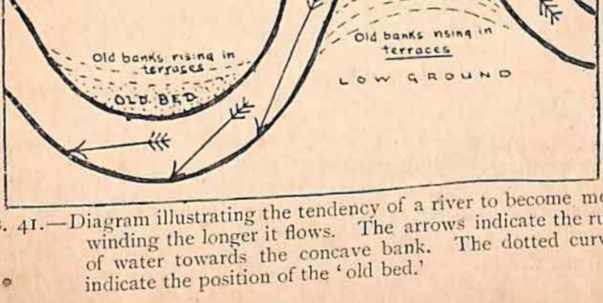

FIG. 41.—Diagram illustrating the tendency of a river to become more winding the longer it flows. The arrows indicate the rush of water towards the concave bank. The dotted curves indicate the position of the 'old bed.'

The aspect of the opposite or convex bank may now be noticed. The contrast between the two banks is very striking. Whilst the bank on the concave side is high and steep the opposite bank is low; it also gradually slopes towards the river. The pupils are taken to the gradually sloping convex bank. They look at the steep bank opposite. From what they have learned above they know that the steep bank opposite is gradually been worn further back by the river's action. Suppose the opposite bank to be worn back a dozen yards, what effect will this have upon the sloping bank on which they stand? The more intelligent of the class may be able to state that it will also change its place. Its movement will follow that of the opposite bank and hence be forward. Future scholars will be able to stand on a bank situated where the river now flows. Looking backwards, in time, the brighter members of the class may be able to state :—

(1) That the river once flowed over the ground on which they now stand.

(2) That, at that time, the river bed must have been at a higher level than the one it flows over to-day.

(3) That, some time very long ago, the river bed was much higher and much straighter that it is to-day.

(4) That some time in the distant future the river bed will be lower and more bending than it is now.

The position of swiftest movement at the bend of the river is not in mid-stream.

It was stated at the commencement of the journey that the notion of the most rapid flow of the river in mid-stream would be modified when the movement of water along the first bend of the river was under consideration. Before leaving this bend the following experiment is made :—

Two bottles are again thrown into the water. One near the middle, the other near the concave bank. The class now sees that the most rapid flow is not always in the middle.

A reason for this shifting of the point of most rapid movement to the concave shore is required. The teacher does not state it; he simply directs the thought of his class *towards* it; he recalls for example, the paper funnel and sand experiment; he allows time for thought; if no explanation be offered, he asks why the sand in the middle falls quickly. The idea of friction and consequent slowness of movement is recalled; that of less friction and more rapid movement is brought to mind. Finally the attention of the class is directed to the opposite, *i.e.* the convex shore; its shallow nature and consequent friction and slow movemement are evident.

The question with which this enquiry started is repeated, viz., 'why does the water flow most rapidly near the concave side?'

The teacher may fairly expect his class to make the following connection between cause and effect, viz., deep water, less friction, hence more rapid movement.

This stage in the 'school journey' has afforded opportunity for observation and experiment. It has further shown the need of caution in making inferences from one set of facts. By changing from the straight course of the river to the bent one, it becomes evident that the popular notion of the stream flowing most rapidly in the middle cannot be always maintained. The cause of rapid motion is therefore changed from the notion of 'position' to that of 'depth.'

With a class sufficiently advanced a third variation in the conditions may be introduced. A second bend following immediately upon the first introduces the notion of 'inertia.' The swinging of the line of most rapid movement beyond the deepest water towards the concave shore results from this additional force. The diagram Fig. 41, p. 69, illustrates this truth. Its fuller explanation is reserved for a later stage in the journey.

It will prove no little gain if the children be thus led to suspend their final judgment. They are apt to fall to conclusions too quickly. Such exercises as the above are admirably fitted to develop the habit of cautious judgment.

The action of running water upon stones.

The scholars are now taken down to the river and are asked to collect a few specimens of stones from the old bed of the river. A little guidance from the teacher enables the pupils to recognise three fairly distinct groups, according to shape. These are shown in the following photo (Fig. 42).

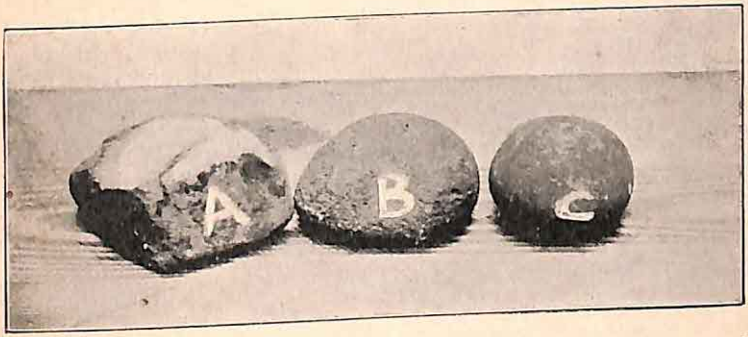

FIG. 42.—Rounding of pebbles by water action. (A) Angular stone; (B) sub-angular pebble; (C) rounded pebble. Photo by Mr. T. Crawshaw.

The scholars are asked to place each of the pebbles he has collected in its proper class. After the classification is completed the scholars are asked to try and find where the pebbles came from, and what brought them. The rock, in the immediate locality, is a soft sandstone. Hence they must have come from another place. If the pupils recognise that the water has rolled them along, then two other facts can readily be told by them, viz. :—

(1) That the stones must have come down the stream, and

(2) That the river has been the means by which they have become rounded.

The scholars are now exercised in trying to determine the relative ages of each class of pebbles. They require but little guidance to find the pebbles which have been rolled most, hence the longest time, and which has been rolled least, hence the shortest time. In this way the pebbles, by their shapes, are made to tell a part of their own life history.

Some uses of a River.

A walk of a few minutes brings the scholars to a large building, situated on the river bank (Fig. 43). This paper-mill is well known to the class. By referring to a previous object-lesson the pupils find but little difficulty in seeing the advantages to the factory of a good supply of water.

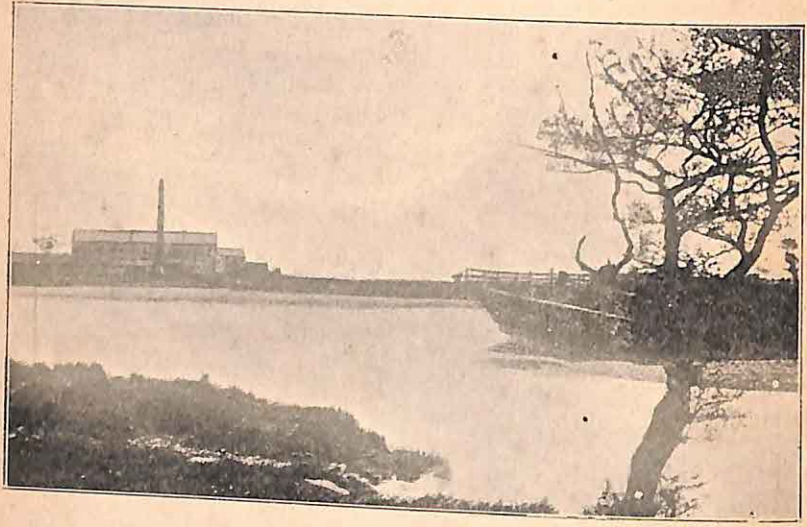

FIG. 43.—Altham Mill and Weir.

A flour-mill is next reached. This mill is hid somewhat by its low position and the thick foliage surrounding it. The scholars are told that they must find a reason for this mill being placed on low ground. The movement of a large wheel attracts attention. The connection of this wheel with the machinery of the mill is briefly mentioned—the full explanation being reserved for a future class-lesson. The attention of the scholars is now directed to a weir in the main stream. When asked, the scholars call this a waterfall. They are commended for their answer. The difference, however, between a real waterfall and the weir is explained, and the use of the weir made clear in the following way.

The scholars return to the small channel which led them to the mill. It is found to be connected with the main stream by doors, which can be either closed or opened.

When open the pupils watch the water rush along towards the mill and over the wheel. After turning the wheel, the water enters the main stream at a lower level. Questions like the following are asked :—

'Does the weir make the level of the water entering the small channel higher or lower?'

'If the water be higher, how does this effect the rate of movement over the mill-wheel?'

The terms 'head of water' and 'mill race' are introduced and applied at this stage.

By this time the scholars are prepared to see the association between the 'weir' and the movement of the flour-mill.

Changes in the river's course. After leaving the flour-mill with its noisy machinery, the historically interesting village of Altham is passed. The chief attraction is the ancient church of St. Mary's, founded during the reign of King Stephen. Old though this building appears, the attention of the class is soon to be directed to much more ancient matters. The records which the river has left through the many centuries of its history are about to be examined. Is this a task beyond the intelligence and interest of school boys? We think not, and so make the attempt.

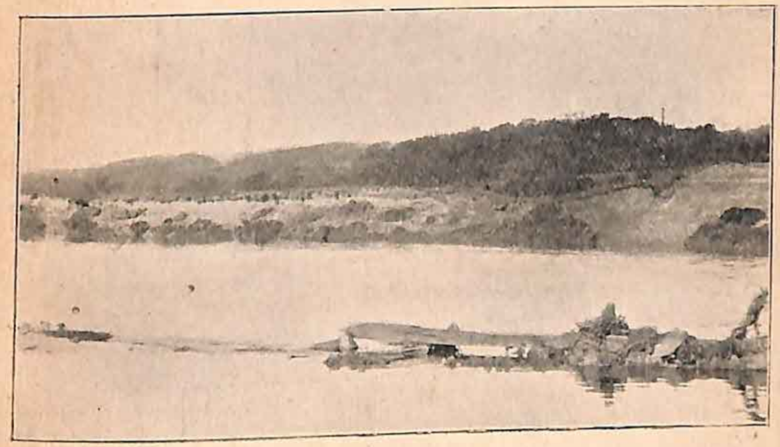

FIG. 44.—Remains of an old stone wall which formerly stood on the left bank of the river, and which now stretches obliquely across the stream.

(*a*). *Changes in the river's course—from almost straight to very crooked.*—Beyond Altham the river flows over level tracts of country and presents very marked contrasts with the appearances presented up to this point. The scholars are asked to state the chief of these changes.

In reply, some say 'the river makes no noise,' 'its flow appears to be very slow,' 'there are no rocks in its bed.' Others, looking further ahead, observe that the river has become very winding.

They are now told that much of the low-lying area through which the river winds has been made by the river itself. The scholars apparently have some difficulty in understanding this truth. They must be assisted in their attempt. The diagram already introduced on p. 69 is again noticed. By its aid they are led to see that as the river becomes increasingly winding it must leave bare the bed over which it formerly flowed.

A very striking effect of this change in a river's course is presented at one of the curves. The remains of a low wall, which, years ago, formed the right bank of the river, may be seen to-day stretching in an oblique direction across the river bed (Fig. 44).

(*b*). ***Changes in the river's course—from crooked towards straight.***—A little lower down the river a change is noted which contrasts very strongly with that noted above. At Dunkirk the river course becomes exceedingly winding (Fig. 45). It doubles back upon itself, and almost encloses a tongue of land. Not long ago and during a period of heavy rainfall, the current broke across the base of this tongue of land, and to-day the water has the choice of two courses; part of it runs along the original winding bed, whilst part flows along the new channel, and enters the main stream again as shown on Fig. 46. Instead, therefore, of becoming more and more winding, the river, at this portion of its course, has become less winding.

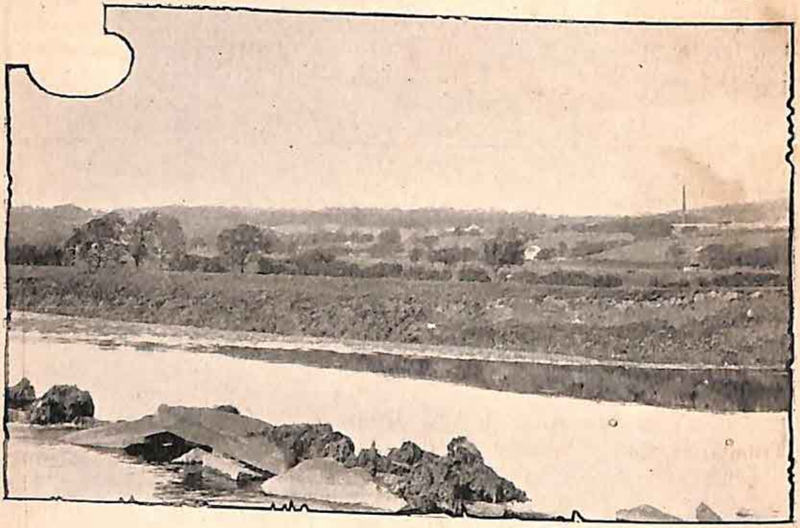

FIG. 45.—Change in the course of the river at Dunkirk. The river here makes a very sharp angle, and cutting through the base of the triangular tongue of land rejoins the main stream lower down.

The scholars are directed to insert the change thus explained on their sketch maps; see p. 63. As the banks of the river are very low the effect of heavy rains in flooding the low-lying areas is noted. The gradual formation of rich pasture land by the deposit of fine muddy sediment after each flooding is indicated, and the word 'alluvial' is explained.

The manner in which a river tends to make a district fertile is thus taught. The connection between fertility of soil and rivers is rarely understood. The statement 'well watered by numerous rivers, hence fertile,' is read, repeated, and accepted, but the full truth is rarely known. The fact that a river drains a district might very naturally be associated with the notion of land left dry and parched, and hence not fertile. Frequently the existence of rivers and of fertile land are separate effects, due to one and the same cause, viz., the falling of sufficient rain. The low-lying areas described above are, however, formed by the winding of the river, and they owe their fertility, therefore, directly to the river's work.

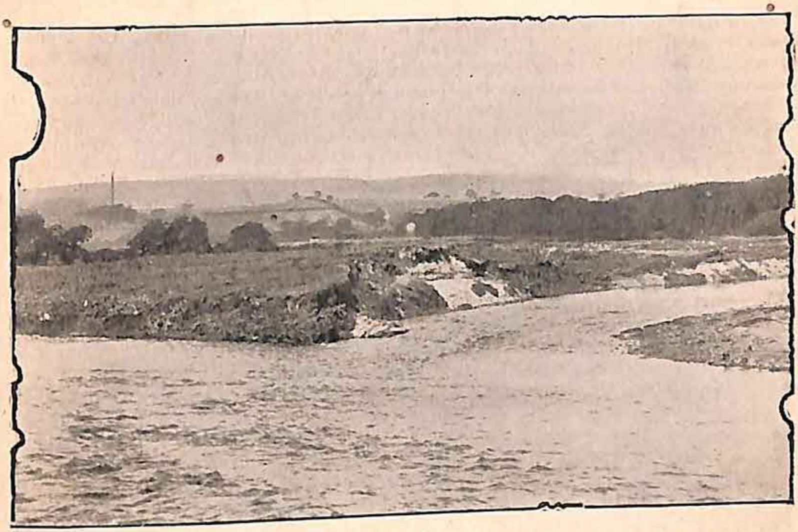

FIG. 46—Main river rejoined by the stream after the latter has broken through the tongue of land—see map p. 63.

Tributaries, Confluence, &c.

After passing Dunkirk the main stream is joined by two smaller contributory streams. The width of the river is compared with its width at starting, and the reason of its increasing width stated. The terms 'tributary' and 'confluence' are marked on the sketch map. As the stream, which hitherto has been called the river, is itself a tributary of a still larger river, viz., the Ribble; the term 'affluent' is applied to both the Calder and its tributaries.

Matter in suspension.

A sample of the water is taken at this stage, and, as the day before had been very rainy, the water is discoloured with sedimentary matter, and a considerable amount of the fine matter is seen gradually settling to the bottom of the bottle. This sediment is then examined and found to be fine sand.

Whence came this sand? is now asked.

Some boys who readily remembered the sandy cliffs between which the river ran during the early stages of the journey were able to answer the question correctly.

Where does the river carry this sand to? is the next enquiry.

Many of the scholars had been to Southport. They were told that the river Ribble enters the sea near that watering place. They were also reminded that sometimes the river overflows the low-lying districts on either side. They are thus able to answer the question asked—some saying 'the sand reaches the sea shore'; whilst others reply 'that it would be spread over the low-lands on either side of the river's course.'

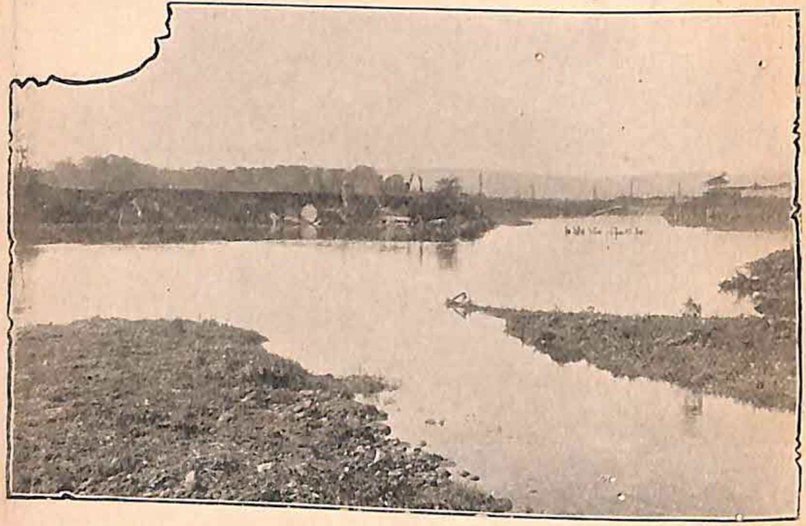

FIG. 47.—Tributary, Dean Brook, joining the Calder, showing confluence.

The journey now affords an opportunity to examine the deposits made at the confluence of one of the tributaries with the main stream. There seems to be a rough arrangement of materials into (a) pebbles, (b) gravel and (c) sand. The following attempt is made to explain this arrangement.

A large bottle is almost filled with water. Small stones, coarse sand and fine silty matter are afterwards thrown in and the bottle is then shaken. The class is required to watch how these different bodies settle. The stones immediately sink to the bottom; the coarse sand also soon settles, but the fine silty matter remains floating for a considerable time. Their attention is now directed to the quickly flowing tributary. Stones and boulders are seen to remain when the river flows very fast, but, when the tributary enters the deeper current of the river its water begins to flow slowly, and, at that point, the sand and silty matter accumulate.

Change of nature of the River Bed. Evidences of Glacial Action.

The entire aspect of the country now changes. In place of the flat sandy and fertile tracts on both sides of the river, it becomes enclosed by steep banks covered with luxuriant foliage and vegetation. The whole scene becomes very attractive, and, for a time, the scholars are encouraged to rest and enjoy the view. Some large masses of rock are indicated. They have fallen into the stream and have become quite rounded by water action. After following this rocky bed for some distance the river passes over a soft sandy rock, and then enters a ravine, one side of which is most precipitous and covered with thick foliage from base to summit. The immense amount of work done by the river in cutting its course through this ravine is very striking.

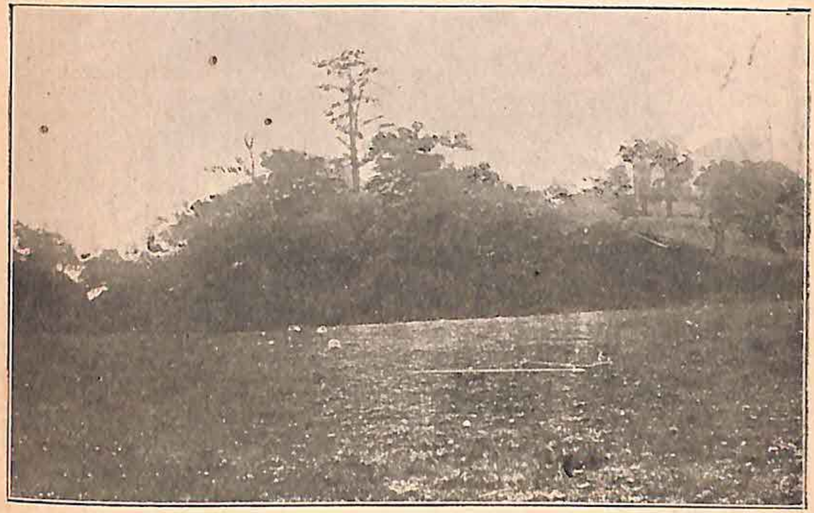

FIG. 48.—Roche Moutonne, a witness of glacial action. Scene of the execution of Paslew, Abbot of Whalley.

The class is apparently becoming weary; instead, therefore, of stopping to give much further direct instruction the time is fully occupied in a restful survey of the beautiful mingling of rock, foliage and water.

Two things, however, remain to arouse interest and awaken thought. A heap of strange stones is examined. They have come from other districts and near the heap is a curiously shaped mound. The river could not produce these effects. Both stones and mound are referred to the action of ice. Full explanation of these must be reserved for future lessons. A historical association with the mound, may, however, be made. During the 'Pilgrimage of Grace,' and the demolition of the Abbeys, the last Abbot of the Monastery of Whalley was executed on its summit.

Watershed and River-basin.

Before terminating the journey the scholars are conducted to the highland overlooking the river valley. From this elevation the river can be seen winding its way towards the sea. Looking directly over the valley the opposite boundary of the basin may be distinctly seen. The valley appears like a huge dish; it serves admirably to impress the notion of a river-basin. The term 'water-parting' or 'watershed' is associated with the high land on either side. By a precipitous descent from a high knoll known as 'Whalley Nab' the somewhat tired travellers enter the charming little village of Whalley.

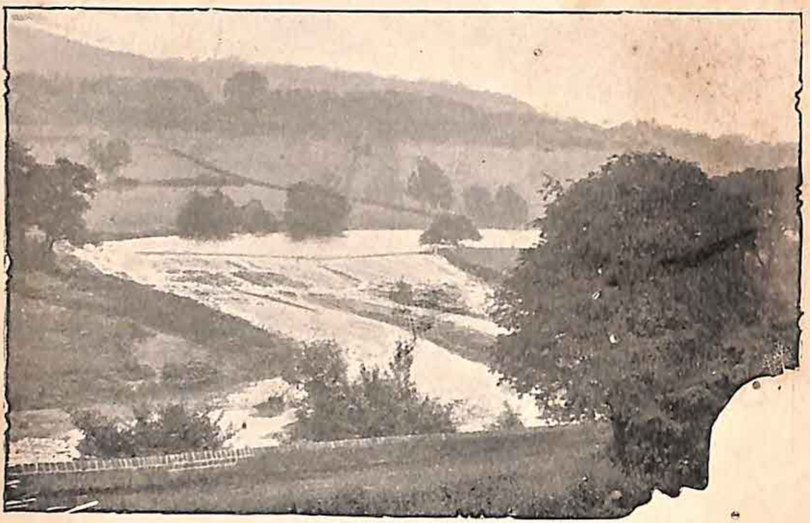

FIG. 49.—The basin of the river as seen from an elevation near Whalley.

Conclusion.

After tea a stroll round the Abbey ruins is very much enjoyed. A short rest and then the homeward journey is commenced. The walk is enlivened by march and song and thus in the cool of the evening the five mile-stones on the pathway home are quickly passed. The account would be incomplete without a passing reference to the sympathy which every 'school journey' develops between teachers and taught. This moral result is of highest value, it softens the relationship between master and pupil throughout the entire range of school work.

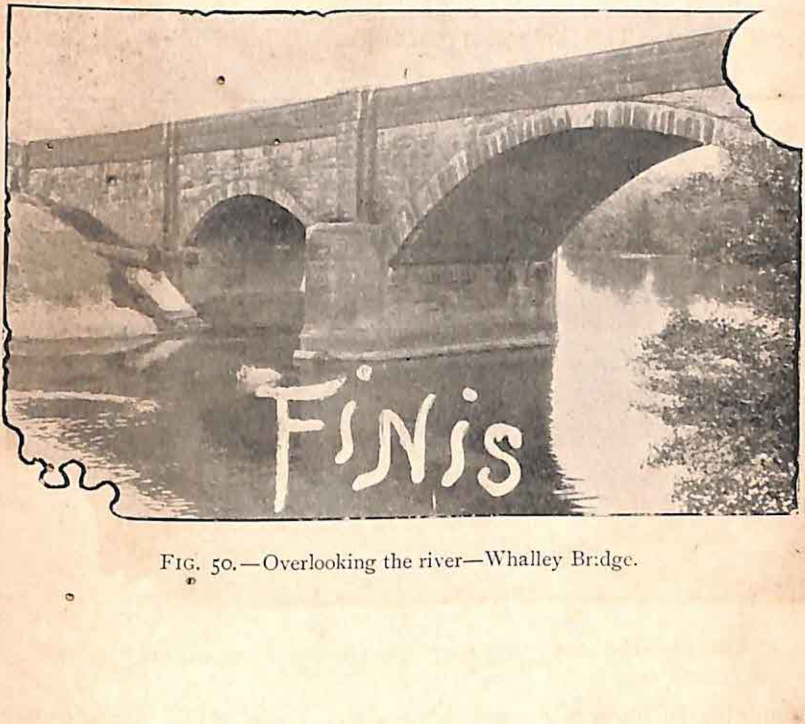

FIG. 50.—Overlooking the river—Whalley Bridge.

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EDUCATIONAL WORKS

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LECTURER ON EDUCATION, WESTMINSTER TRAINING COLLEGE,
LONDON, S.W.

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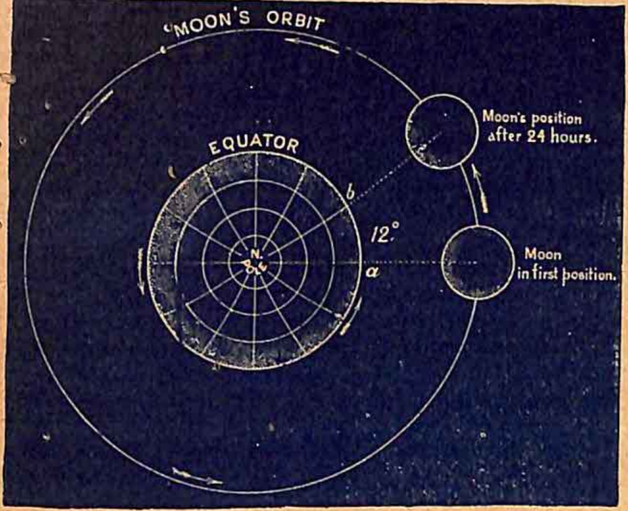


Fig. 1. Illustrating the causes of the tides being 48 minutes late every day.

Extract from the Government Blue book, 1884-5 p. 423.

'The home-made apparatus at the Westminster Training College deserves special notice. A few shillings only have been expended on making such very useful articles for teaching as "a set of coloured globes to show the phases of the moon; plan of the moon's orbit crossing the ecliptic, with lines of nodes, and many others."'

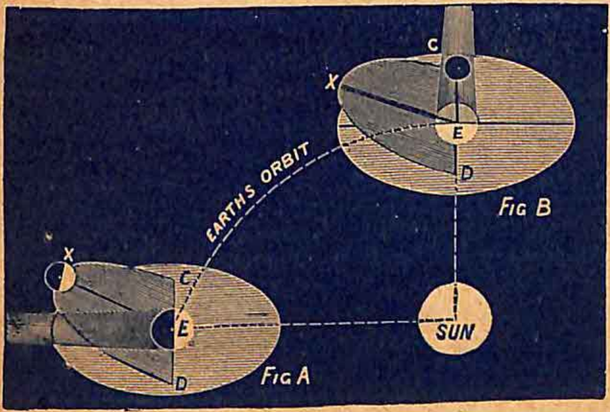


Fig. 2. Showing why an eclipse of the moon does not occur every month at 'full moon'—

At B the moon is eclipsed.

At A the moon is above the earth's shadow and is not eclipsed.

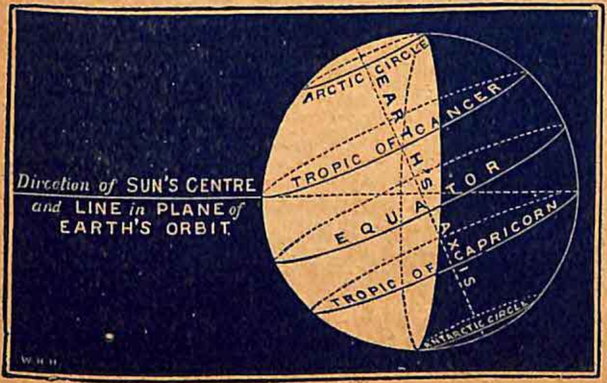


Fig. 3. Representing the distribution of light over the earth's surface at the *Summer* Solstice, and showing why the days decrease in length as we proceed from the arctic circle southwards to the antarctic circle.

'Very simple yet remarkably effective appliances for elementary geographical instruction.' *Nature.*

The above are specimen illustrations from Cowham's 'Graphic Lessons in Physical and Astronomical Geography.'

Specimen of Lesson

THE SHAPE OF THE EARTH.

MATTER, INCLUDING EXAMPLES AND TRUTHS THEY TEACH.

A. Objects on a curved surface.

1. If we take a large ball and place small objects upon it, these are visible to each other when very near, but when they are slowly removed away from each other they gradually disappear from view.

   In Fig. 1, from A, the fly B will be in full view; the fly C will be just coming into sight, whilst D will be completely hidden from view.

2. Similarly, ships sailing over the surface of the ocean, when they leave the shore, gradually disappear from view, leaving only the upper portions of their masts visible, and these at last pass out of sight.

Reasoning.—If the sea were a flat surface, the large hull would be last seen, but this disappears long before the thin masts, we therefore infer that **the surface of the sea is curved.**

B. Shadows cast by spheres.

1. The shadow of a sphere is circular in shape when that shadow is thrown upon a screen held perpendicularly to the direction of the shadow.

   In fig. 3, if we place a light at LP, and a ball at Sp, then S represents the circular shadow on the screen AB.

2. Similarly when the shadow of the earth is projected on the surface of the moon it is seen to be circular in shape. This occurs only when there is a partial eclipse of the moon. In Fig. 4 the diagram represents a simple apparatus by which the round shadow upon the moon may be illustrated.

3. In Fig. 4

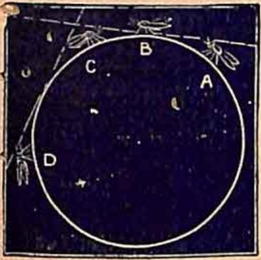
   B is a black cardboard cylinder wrapped round the globe to represent the cone of shade behind the earth.
   A represents the moon partially in the shade.
   C shows the shape of the shadow thrown on the moon's disc.

We infer:—

Because the earth's shadow when it passes over the moon is circular, and only spherical bodies in all positions throw round shadows, therefore THE EARTH IS A SPHERE.

taken from 'Graphic Lessons.'

ILLUSTRATIONS AND TEACHING HINTS.



A. Fig. 1. Allow children to place the objects standing for flies in various positions, and to state when they are in full or partial view of each other, and thus lead the Class to see that the change of view is due to the curvature of the surface of the ball.

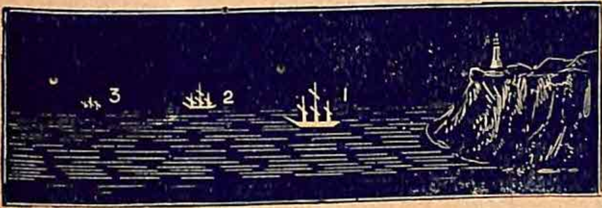
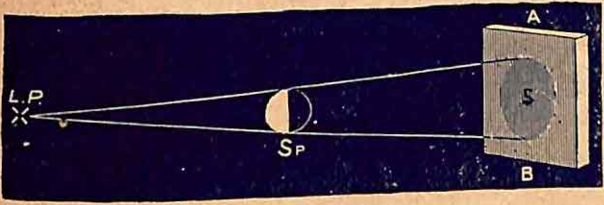


Fig. 2. Show, and ask the children to point out, the difference in the appearance of each ship; then ask them to explain, if they can, what they see. If they cannot do this, refer again to the ball and flies, until they connect the change in the appearance of the ships with the curvature of the surface of the sea.



B. Fig. 3. This figure shows how a spherical body may be seen to throw a circular shadow.

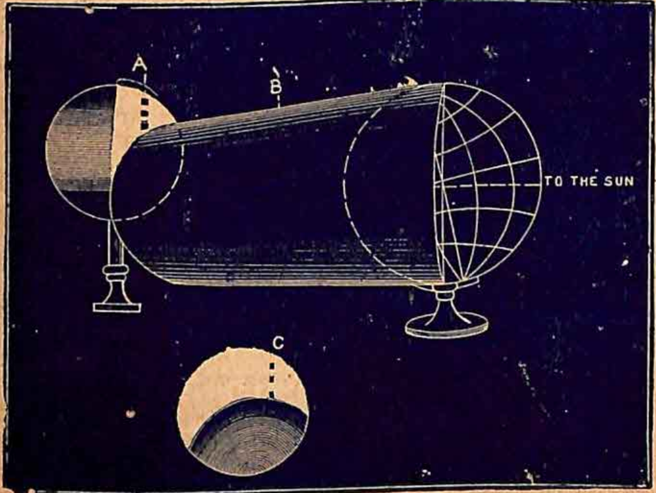


Fig. 4. Appearance of the moon when partially eclipsed by the earth's shadow. The shadow is a round one, as seen in C.

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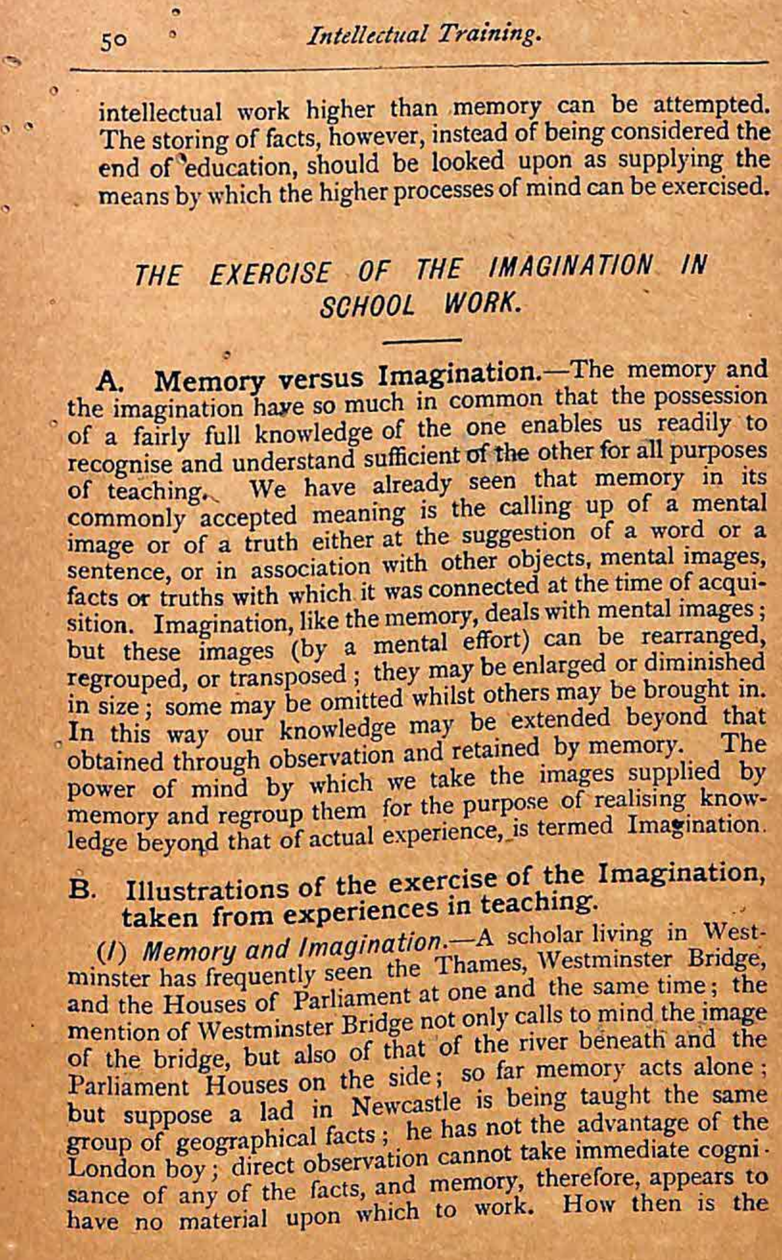
For Specimen Pages of 'Principles of Oral Teaching' see next two pages.

Specimen Page from 'Principles of Oral Teaching and Mental Training' (Elements of Psychology).



50 *Intellectual Training.*

intellectual work higher than memory can be attempted. The storing of facts, however, instead of being considered the end of education, should be looked upon as supplying the means by which the higher processes of mind can be exercised.

THE EXERCISE OF THE IMAGINATION IN SCHOOL WORK.

A. Memory versus Imagination.—The memory and the imagination have so much in common that the possession of a fairly full knowledge of the one enables us readily to recognise and understand sufficient of the other for all purposes of teaching. We have already seen that memory in its commonly accepted meaning is the calling up of a mental image or of a truth either at the suggestion of a word or a sentence, or in association with other objects, mental images, facts or truths with which it was connected at the time of acquisition. Imagination, like the memory, deals with mental images; but these images (by a mental effort) can be rearranged, regrouped, or transposed; they may be enlarged or diminished in size; some may be omitted whilst others may be brought in. In this way our knowledge may be extended beyond that obtained through observation and retained by memory. The power of mind by which we take the images supplied by memory and regroup them for the purpose of realising knowledge beyond that of actual experience, is termed Imagination.

B. Illustrations of the exercise of the Imagination, taken from experiences in teaching.

(I) Memory and Imagination.—A scholar living in Westminster has frequently seen the Thames, Westminster Bridge, and the Houses of Parliament at one and the same time; the mention of Westminster Bridge not only calls to mind the image of the bridge, but also of that of the river beneath and the Parliament Houses on the side; so far memory acts alone; but suppose a lad in Newcastle is being taught the same group of geographical facts; he has not the advantage of the London boy; direct observation cannot take immediate cognisance of any of the facts, and memory, therefore, appears to have no material upon which to work. How then is the

Specimen Page from 'Principles of Oral Teaching and Mental Training.'

Geography and Imagination. 51

knowledge to be acquired? By the following method:—the Newcastle boy has seen the river Tyne, has perhaps been towards its mouth, he knows the high level bridge joining Newcastle with Gateshead, and he is well acquainted with the buildings on either bank of the river. All these are quite familiar, and a good image of each of the facts comes to mind immediately each name is mentioned. So far, he adds nothing to his stock of knowledge; following, however, the directions of the teacher, he mentally widens the river, he lowers the bridge, instead of factories he places on the banks the most magnificent buildings he has seen, and in this way his mind, aided by pictures and his teacher's statements, effects quite a transformation in the group of images which his memory at first supplied. The Newcastle boy thus obtains a fairly full and accurate notion of the Thames and its associations at Westminster. **This transformation of the images of memory is an example of the intellectual effort termed Imagination.**

(2) *Geography and Imagination.*—A very large part of the knowledge of the descriptive geography of his own country, and that of all distant lands not actually visited, is gained by the aid of imagination. This intellectual power uses up the materials which observation, aided by pictures, models and maps, supplies, and elaborates out of these materials fresh geographical knowledge. When thus we consider that nearly the whole of our knowledge of the surface, of the contour, and of the inhabitants (with their appearance and modes of life) of all the countries of the world beyond the narrow range of our own actual experience, is elaborated for us by imagination out of the scanty materials which experience supplies, and which memory recalls, two truths become very evident, viz.: (1) the great importance of the imagination for the purposes of gaining new knowledge; (2) the necessity of first obtaining a large amount of observed knowledge upon which the new knowledge may be based.

Practical Suggestions for teaching Geography.

(*a*) *The varying condition of children as to their stores of observed knowledge upon which their imagination must be based.*

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The Educational Times writes:—'Mr. Cowham's excellent "School Method." The use of his book by those who are beginning educational work in secondary schools will save an infinite amount of time, energy, and temper.

The Journal of Education writes as follows:—'It has often fallen to our lot to have to look into and read books on school method for pupil-teachers; and in by far the majority of cases we have found such books narrow, mechanical, and not infrequently very ill-informed. We soon found, however, that Mr. Cowham, Lecturer on Education at Westminster Training College, has used his twenty years' experience in training to much better purpose. He sets forth his principles clearly and with sufficient fulness, and applies them carefully and with adequate explanation to the subjects with which he has to deal. To our mind the best section in the "New School Method" is that on the teaching of Geography. It is right and sound in principle, and clearly and graphically expounded and illustrated. Very satisfactory, too, is the emphasis laid on the principle that "object lessons" should be used as the informal beginnings of science. But perhaps the best feature of the book is the frequent insistance on the principle that school subjects must not be considered as isolated wholes. *We certainly like the book.*'

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Specimen Page from 'New School Method.'

shaping their imperfect statements into forms more perfect. The introduction of nursery rhymes and simple stories will be found helpful to correct speech at this stage.

GOOD READING:—JUNIOR STAGE.

WHAT IT IS, AND HOW TO TEACH IT.

Introduction.

In previous pages we have dealt with that part of our subject which may be termed 'learning to read,' so far as the phrase includes (1) a knowledge of the letters of the alphabet, and (2) a knowledge of the spelling and pronunciation of simple words. Our subject changes at this point, not only in the efforts it demands, but in the processes it requires, and the ends it secures. In this introductory statement it will be sufficient to mention the ends aimed at, leaving the efforts and the processes required to secure these ends to be gradually unfolded. The ends in view, in the reading of scholars in our upper classes, are (1) the full, clear, and accurate utterance of every word, (2) the interpretation of the meaning of the passage as a whole so that the thoughts of the author are conveyed by the voice of the reader, and (3) the fluent and expressive rendering of the passage read. The first of these features of good reading is generally summed up in the term 'pronunciation,' the second is marked out by the term 'reading with intelligence,' and the last feature properly belongs to the subject of 'rhetoric.'

A more detailed analysis of the chief features of good reading is shown in the following tabular statement:—

(*a*) **Pronunciation.**	(*b*) **Intelligence and Expression.**
1. **Articulation,** *i.e.*, the use of the vocal organs in the production of the required sounds.	1. **Fluency,** *i.e.*, the power to recognise words and to convey their correct pronunciation and meaning without either haste or hesitation.
2. **Enunciation,** *i.e.*, the power of uttering clearly and distinctly the different parts of each word and syllable.	2. **Emphasis,** *i.e.*, the different stresses placed upon the words in a sentence in order to convey meaning.
3. **Accent,** *i.e.*, the differences of stress placed upon the syllables of a word.	3. **Expression,** *i.e.*, the changes of tone and rate by which feeling is conveyed by the voice.

Specimen Page from 'New School Method.'

notion of 'place value.' The following is a sketch of a lesson designed to assist them over this difficulty:—

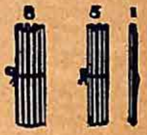
OUTLINE SKETCH OF A FIRST LESSON ON 'PLACE VALUE.'

Plan and Matter of Lesson. **Illustrations.**

1. *Concrete examples—preliminary.*

Distribute sticks or cubes, &c., to the number of 30 or 40 to each child. Exercise the class in placing together various groups of sticks, from one to nine in each group.

This will be familiar work, and need occupy very little time. Care must be taken to associate each bundle with the figure representing it in the abstract.

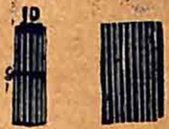


(*a*) Bundles of single sticks.

2. *First notions of tens.*

Place ten single sticks side by side; count them, and then tie into a single bundle. Call this *one ten.*

Allow the children to make similar bundles, and group these into two, three, or four tens. Deal similarly with peas, marbles, &c.

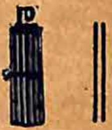


(*b*) One ten. Ten single sticks.

3. *Combinations of tens and units.*

Proceed to combine a tens bundle with one or more of the single sticks. These latter should now be termed *units* to distinguish them from the bundles (tens).

For example, let one ten be combined with two units, as in fig. *c*. The name *twelve* may now be supplied; the scholars at the same time should decompose the number into one ten and two units. Combination of one ten and three units, one ten and four units, &c., should follow. The names *twelve, fourteen,* &c., should be associated with the concrete number as soon as each is represented by means of sticks.

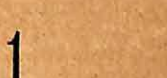


(*c*) One ten. Two units.

4. *Graphic figures.*

The mode of representing by ordinary figures may now be approached, but not by a single step. The figures representing tens and units are usually made the same in size, whereas they stand for very different values.

Do not risk confusion by writing the ordinary symbol for twelve too soon. It would be better to make a graphic representation of the relative values of the two figures as shown in fig. *d*. Deal similarly with the figures fourteen. fifteen, &c.



(*d*) One ten and two units = twelve.

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For Specimen Pages see pages 13 and 14.

Specimen Page from 'School Organization, Hygiene, and Discipline' (Ethics).

66 *School Ethics.*

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tracing action back to motive, is sometimes deceived, and hence unsound moral judgments are passed. If the teacher take account merely of the outer action of his pupils, he must sometimes be in danger of judging unfairly. It is much safer to compare a scholar's present action with that of the same scholar in the past, than to compare scholar with scholar in the mass. Another difficulty in determining motive arises from the influence which children, in the same class, exercise over one another. It will frequently be found that a pupil does what the others do from a mere imitative tendency, or from fellow sympathy. It is well, at times, to require exercises which demand a certain amount of individuality. A scholar entirely unaccustomed to act on his own initiative and responsibility must not be expected to develop a sufficiently self-reliant and manly character.

Distinction between 'right' and 'good' Conduct.—Conduct is described as either (1) right or wrong, or (2) good or bad. The terms 'right' and 'good' are not quite synonymous. Right is applied to conduct which is according to rule or law. It is the rule of the school that pupils be in time, that they be diligent during the school hours, &c. Obedience to these and similar rules results in action which is properly termed 'right.' The goodness or otherwise of conduct depends upon the quality of the motive. It has been shown that motive is the idea of some aim, object or end, which, when pictured to the agent, induces him to activity. He acts in order that the end may be gained. In this case, it is not so much the teacher's presence, nor the stimulus of his commands, nor is it the mere obedience to school rule which moves to action. These are external forces, whilst the motive is a force acting from within, and hence directly personal. A scholar is industrious during lessons. Why? In reply, his industry may not be in response to rule or command so much as from an inward regard for knowledge or for the power and position which the possession of knowledge secures. The term 'good' is applied to the self-directed (motived) activity by which the knowledge is gained.

> It becomes at once evident that the action termed 'good' is the one containing the most of voluntary effort; and this voluntary effort is that which is most properly dignified as moral. At the same time, it is well known that only during the later years of school life can frequent appeals be made to the higher forms of inducement. Much of early school effort must necessarily be subject to the personal presence and direct command of the teacher. The more direct the command and presence of the teacher, however, the less valuable is the scholar's action from a moral point of view. Moral training, to be sound, must be progressive. Little learners should be required *to do what is right*. As they pass through the various stages of school life, there should be manifested, more and more, the power *to be good*.

Specimen Page from 'School Organization, Hygiene, and Discipline' (Ethics).

Disadvantages of the open fire.—(1) a great waste of heat, as very much escapes up the chimney; (2) unequal warmth, the distant regions remaining comparatively cold; (3) cold draughts for the feet; (4) the need of frequent attention, and an untidy appearance of hearth; and (5) the danger of young children catching fire.

It is estimated that an open fire withdraws about 20,000 cubic feet of air up the chimney per hour. Unfortunately this air is not necessarily impure, for the tendency must be to take the air which has forced its way under doorways, along the lower regions of the room, thus leaving the middle layers of air stagnant and impure. In order therefore to increase the warming power of the open grate, and to cause a change in the middle and upper layers of air, various modifications of the open fire have been adopted. Added to these, for purposes of more perfect ventilation, are certain devices for the admission of fresh pure air into the middle or lower portion of the room, and the exit of foul air near the ceiling.

Modifications of the open fire, designed to secure greater warmth together with the circulation of fresh warmed air.

In order to utilize the heat at the back, the sides, and the bottom of the grate, a hollow chamber B, lined with fire brick or fire clay, is arranged as shown in the adjoining fig. This chamber receives the fresh air direct from the outside at K; the fresh air is warmed in the chamber and then passes into the room from a grating C, immediately above the mantel-shelf E. Grates made on the principle just described have received various names, according to slight modifications in their structure. They are called the Galton, Manchester, Boyd, Pierce or Longden grates.

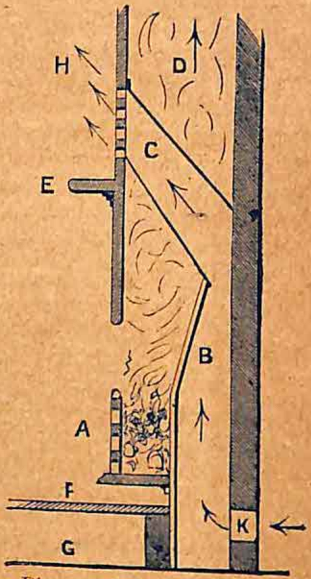

Diagram of a Manchester Grate.

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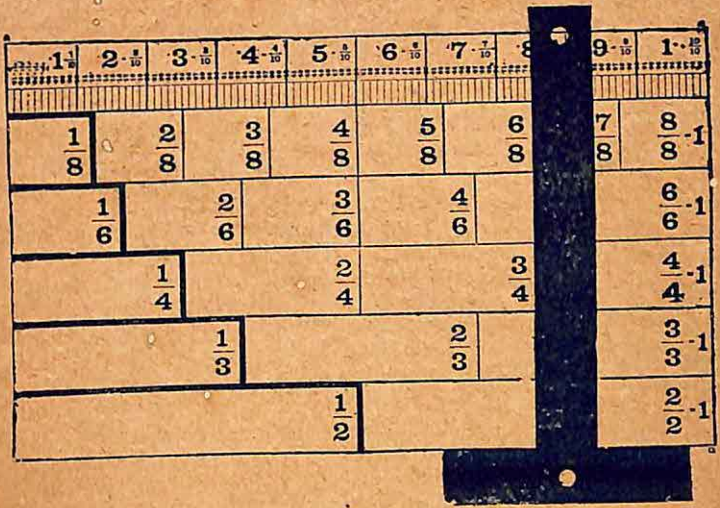

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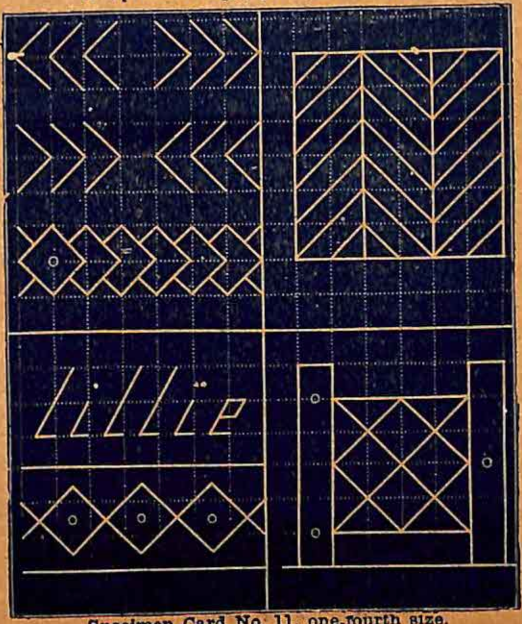

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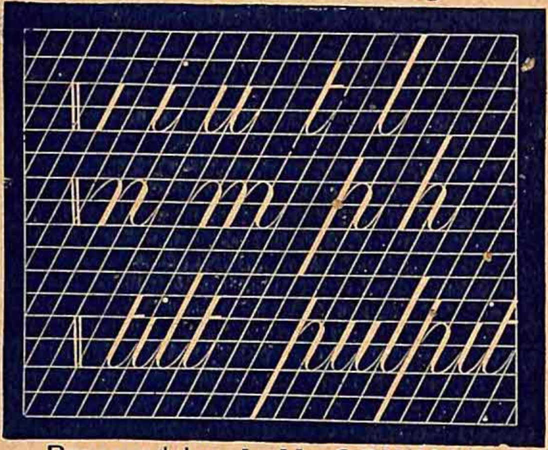

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